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A HANDICAP ON UNITED STATES BATTLESHIPS.

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Table 1 herewith, for which the date, except for the United States battleships, was obtained from Brassey's Naval Annual for 1904, gives some comparative dimensions, etc., of the principal recent types of battleships of seven nations. The figures as given by Brassey are not exactly comparable. For instance, the length for our battleships is the length on the waterline, while for the English and Japanese ships it is the length between perpendiculars, the length on the water line for these ships being probably from fifteen to twenty-five feet greater than the length between the perpendiculars. However, for rough comparisons, the dimensions given can probably be used without serious error.

There are several features of Table 1 which appear worthy of comment. The exceptionally small beam of the Kaiser Wilhelm II and the Wittelsbach causes those of us who are aware of the fact that the metacentric height of our low freeboard Indiana class (of 69¼ feet beam and 10,288 tons displacement at 24 feet mean draught), though adequate, is not excessive, to speculate as to the stability of the toplofty Germans. It will be noted that the

vast majority of battleships are designed for an 18 knot speed. The Czarevitch is credited by Brassey with 19.6. This was probably the speed reported by the builders. The two Italian ships are more of the armored cruiser type as regards proportions than the battleship type. The estimated speed of 22 knots of the Vittorio Emanuelo III will, according to the estimates of the design, be obtained with 20,000 horse power only. It is true that this vessel has a very low block coefficient for a battleship, but if the speed of 22 knots is obtained by her with 20,000 horse power it will show that the Italians have discovered a shape for their vessels far superior to anything known to the rest of the world. The block coefficient of our Baltimore is practically the same as the designed block coefficient of the Vittorio Emanuelo III. If we take the Baltimore shape, which is excellent for speed, and change the dimensions to produce a vessel 435.5 feet long, 74 feet beam, 27 feet mean draught and 12,425 tons displacement, assuming the very maximum possible efficiency of propulsion (which this type of vessel could probably not obtain) it would require 25,000 horse power to send her 22 knots. It will be interesting to see whether the estimated results for the Vittorio Emanuelo III will materialize.

Apart from the Italian battleships, the column of block coefficients of Table 1 shows remarkable variation, not only from nation to nation, but between successive battleships of the same nation. The United States battleships have consistently high block coefficients for reasons which I will explain later. England, Germany, Japan and Russia appear to be following us in this direction, their latest ships showing the highest block coefficients. France in her later ships has reduced block coefficient and appears to be working in the direction of the Italians. This is undoubtedly a mistake for the moderate speed aimed at by the French battleships and goes far to account for the very high powers which the French seem to give their ships for a given speed in comparison with corresponding English ships. Our high block coefficients are associated with extremely shallow draught in comparison with foreign ships of the same size. The mean draughts given in the table are the designed draughts at normal displacement, extreme draught in each case being a good deal greater, but probably the extreme draughts would compare very much as the designed normal draughts. It is seen that even for

the 16,000 ton Connecticut we hold to a draught of 24½ feet. England, France, Italy and Japan adopt draughts of 26½ feet and more. Russia appears not to wish to exceed 26 feet. Germany, with her comparatively shallow harbors, in spite of the increasing size of her battleships, has reduced their draught until her latest ships are remarkably close in this respect to those of the United States.

The following extract from the report of the Secretary of the Navy for the year 1896 gives a discussion of the question of draught for our battleships, and appears to indicate that the official reason why the Kearsarge and Kentucky were designed to be of such light draught was primarily that they might take refuge in our shallow harbors from deep draught foreign battleships.

"When the Department undertook in 1894 the task of laying down battleships, the draughts of the Indiana and Columbia classes having been brought to its attention, the Bureau of Construction was directed to prepare plans for the new vessels that should give them 2 feet less draught. It was urged that there were difficulties in the way, but the order was insisted upon and was carried out. The battleships laid down during this administration are, therefore, of lighter draught than those previously designed proved to be when completed, being 23 feet at normal and 25 feet at extreme draught. This step, which was in the right direction, it now appears did not go far enough, or perhaps it would be fairer to say that the battleships heretofore laid down, while adapted for the defense of the Atlantic and Pacific coasts, are not as well suited for operations in the Gulf of Mexico. Attention is called to the following recommendation from the President of the War College:

"The close study of the Gulf of Mexico which has been carried on by the Department's order during the last year shows it to be essential to the success of defensive naval campaigns that we shall be able to use for our fighting ships those harbors which nature has provided. Although possessing bases for fleets in that region, the fact that there is not enough depth of water for our fighting ships to enter them will render them of but slight benefit to us.

"It is submitted further that the artificial deepening of channels and entrances is not a good solution of this difficulty, because such dredged channels are of necessity narrow, easily blocked, and very sensitive to injuries from an enemy or the elements.

"The effort to remedy a shoal entrance by dredging a narrow channel across the bar seems unwise as far as naval and military questions are

concerned, and the true remedy, in the opinion of the War College, lies in decreasing the draft of the warships to a point permitting them to enter.

"The College therefore respectfully suggests that future ships of war be planned for an extreme deep-load draft, with maximum coal supply on board, of 23 feet, and submits that considerations of strategy upon our Atlantic and Gulf coasts render this an essential to successful naval campaigns."

This reasoning is the final result of much careful study by able officials of conditions as they exist on our Southern coast. Battleships that could enter the harbors of Savannah, New Brunswick, Key West, Tampa, Pensacola, Mobile and the mouth of the Mississippi at all times would have an immense advantage over the battleships of foreign nations, few, if any, of which could enter these ports. Light-draught battleships, if we had them, could make any of these ports bases of supply, could sally forth from them or retire into them at will, and could therefore almost always offer battle on their own terms.

There are also many of our ports farther north which would give the same advantages to such ships.

I therefore recommend the authorization at the coming session of Congress of three such battleships."

Secretary Herbert was slightly in error in stating the designed draught of the battleships laid down under his administration. It was 23 feet 6 inches at normal displacement and about 26 feet maximum at deep load. These figures have been increased to 24 feet 6 inches and 26 feet 9 inches for the 16,000 ton Connecticut and Vermont classes, which are designed to draw under similar conditions more than 2 feet less than the 16,350 ton vessels of the King Edward class. The War College recommendation of nearly ten years ago limiting the extreme draught of our ships to 23 feet would probably not be renewed today by a large proportion of officers.

It has been always known in a qualitative way that our battleships were handicapped as regards speed by their shallow draught. Some of the experiments during the last year at the Experimental Model Basin have shown quantitatively the amount of this handicap.

Speaking roughly and neglecting a host of secondary considerations we may say that a battleship should have not less than a certain length appropriate to her speed, a certain beam necessary for

stability, and a certain draught necessary to obtain her displacement on the length and beam without giving a form too full for the designed speed.

The water line length of these full ships appropriate for a given speed does not vary much. I would fix it about as below.

Required speed in knots.....	16	17	18	19	20
Appropriate water line length in feet..	320	361	405	451	500

If ships of full form like our battleships are made much shorter than the appropriate lengths for speed above, the speed can be attained only by the provision of excessive power.

For ships of finer forms the lengths may be made less than stated above without serious prejudice to speed. As length is not a desirable quality for a battleship unless necessary for speed, it would be desirable in practice not to exceed the figures above. But in the case of our 18 knot Connecticut class, even after giving ample beam, the length had to be made 450 feet because of the restricted draught. True, the Connecticuts are liberally powered and should make nearer 19 knots than 18 on trial, while the 435 foot, 19 knot, Virginias will have to extend themselves to the utmost in order to make 19 knots. Even allowing for this, the Connecticuts are undesirably long. The 375 foot, 17 knot, Idaho class have a length well adapted to their speed, and while they will be much more crowded than the Connecticuts and not such happy homes, they will be far superior to them in offensive and defensive power per ton of displacement.

Returning now to the question of speed I may point out that the shallow draught of our ships has been an important factor in impelling us to adopt very flat and full midship sections. This is the only possible way in which the high block coefficients which we have been compelled to use can be associated with reasonably fine water lines. Fig. 1 shows the midship sections of our 13,000 ton Idaho and the 14,000 ton English battleships of the Royal Sovereign class. The full midship section is somewhat weaker transversely owing to its flatness but it undoubtedly obstructs rolling more than a rounding section, and had we not adopted it we should have fallen materially short of the actual trial speeds attained.

In order to investigate the effect of draught upon the speed of a 16,000 ton battleship, models were made representing eighteen

different ships, all of 16,000 tons, 450 feet length and 76 feet 10 inches beam, the same as the Connecticut. Three different draughts were used. For each draught three different midship section coefficients were used, making nine midship sections. For each midship section two different types of lines, A and B, were used, thus making the eighteen models. But, as the models were cut in the middle, for each midship section used a type A bow could be recombined with a type B stern and *vice versa*, thus enabling 36 models to be tried. The type A lines for both bow and stern were found the best in practically all cases. From the results of towing experiments upon the nine models of this type I have plotted Fig. 2. This shows the net or effective horse power required by 16,000 ton ships to make 18 knots for various draughts and values of cylindrical coefficient, the cylindrical coefficients being the actual volume displaced by the ship divided by the product of midship section area and length.

Contour curves for 6 inches intervals of draught are drawn. It is seen that these reach a minimum in nearly every case. This minimum of course corresponds to the best combination of midship section coefficient and cylindrical coefficient for the constant draught.

Fig. 2 has on it the spot corresponding to the actual Connecticut. It will be seen that this is located almost directly above the minimum of the contour curve for 24 feet 6 inches mean draught, the mean draught of the Connecticut. This shows that the combination of cylindrical and midship section coefficient chosen for the Connecticut was about the best obtainable. The fact that the Connecticut spot falls above the contour curve for 24.5 feet in Fig. 2 shows that the shape of the models from which the contour curves were obtained is slightly superior to that of the Connecticut.

From diagrams similar to Fig. 2 for other speeds than 18 knots data was obtained to plot Fig. 3. For each draught the minimum I. H. P. for each sped was taken, and being set up above its speed the spots so obtained were joined by curves.

Finally taking the speeds in Fig. 3 corresponding to 7920 E. H. P. (the E. H. P. of the Connecticut for 18 knots is 7920) Fig. 4 was plotted. This shows the speed which would be obtained from 16,000 ton ships of various draughts on the power of the Connecticut if the latter makes 18 knots only. The Connecticut

mean draught is 24 feet 6 inches and it is seen that on this draught the speed to be expected from Fig. 4 is 18.16, or .16 more. This expresses the superiority of the type A lines over the original Connecticut lines. It is seen that in addition if the draught were increased from 24 feet 6 inches to 26.75 feet the increase of speed would be .50 more. This does not seem very much, but when expressed in horse power instead of speed the results are more illuminating. Assuming the same efficiency of propulsion as necessary to send the Connecticut 18 knots with 16,500 I. H. P., I show in Fig. 5 curves of the I. H. P. required to drive 16,000 ton, 450 foot, battleships at various speeds plotted on mean draught. This figure shows that for 18 knots we could without changing the draught of the Connecticut by improving the lines reduce the I. H. P. required from 16,500 to 16,000, and by increasing the draught to 26.75 feet we could effect a further reduction of over 2000 I. H. P. to 13,900. Now horse power costs money, requires a lot of weight, and, what is becoming a more and more serious matter in our battleship designs, occupies a lot of space. Moreover, if the maximum I. H. P. were reduced from 16,500, to 14,000, the endurance of the Connecticut at 10 knots would be materially increased—fully 7½% according to my estimates.

I am well aware that light draught is an excellent thing in ships and that much may be said in its favor. Its disadvantages are not so obvious, and these I have endeavored to bring out by a concrete example.

I think there is no doubt that unless we are willing to increase the draught of our large battleships we must give up any idea of materially increasing their speed without reducing offensive or defensive qualities. It will be noted that the coefficients of the Connecticut are almost exactly those that are best for a draught of 24.5 feet. The lines of the Connecticut are an evolution of experiments in the Model Basin and much superior to those of our previous battleships. As a result of the systematic experiments I have described we can improve on them sufficiently to make a gain of but a little less than .2 of a knot on the same power. The Connecticut class, however, are very liberally powered and if pushed on trial should show a maximum speed well above 18½ knots. The Virginia class, on the contrary, must

be pushed to the utmost on trial if they are to reach the 19 knots contracted for. So the five vessels of the Connecticut class and the five of the Virginia class will be practically on even terms as regards maximum trial speed. In ordinary cruising, however, the Virginia class when developing a given percentage of maximum trial power will show probably nearly a knot more speed than the Connecticut class, so that even if the Connecticut reaches 19 knots on trial the Virginia would still have nearly one knot superiority under cruising conditions.

We are not likely to increase the speed of future 16,000 ton ships by improvements in lines. We must increase length, increase horse power or increase draught. Increase of length is objectionable and not very profitable as regards increase of speed. More weight would have to go to hull. The same armor weight would give equal protection to less percentage of area of the longer ship or else the armor thickness would have to be reduced. Moreover, the increased weight required for hull would probably have to come out of armor.

To increase horse power would require more weight, which would have to come from somewhere and also require more space to be allotted to machinery. This space would be hard to find.

To increase draught would involve no appreciable increase of weight and would be thus the cheapest method of obtaining something like an extra half knot of speed.

For my part I have never been an advocate of high trial speed for battleships, and, if shallow draught is worth anything, it should easily be worth a half knot of trial speed. The object of this paper is to point out, however, that shallow draught is a real and positive handicap to speed in the case of our 16,000 ton battleships, and that the cheapest way of obtaining an additional half knot would be by the sacrifice of the shallow draught, a sacrifice which would not cause indirectly material sacrifices as regards any other quality.

While we have not covered the ground experimentally, I believe that as regards the armored cruiser type, which have practically the same draught as our battleships, their shallow draught, being associated with materially greater length and a finer block coefficient, is little or no handicap to speed. These vessels, however, are necessarily weaker in offensive and defensive power than the battleships.

TABLE I.

DIMENSIONS AND DISPLACEMENTS OF VARIOUS BATTLESHIPS.

NATION.	NAME OF BATTLESHIP.	YEAR OF LAUNCH.	Dimensions in feet at designed normal displacement.			Designed normal displacement in tons.	Block coefficient.	Trial speed designed or actual in knots.
			Length.	Beam.	Mean Draught.			
ENGLAND	King Edward VII	1903	425	78	26.75	16,350	.645	18.5
	Prince of Wales	1902	400	75	26.75	15,000	.654	18
	Albemarle	1901	405	75.5	26.5	14,000	.605	18.6
FRANCE	Republique	1902	438.75	79.5	27.5	14,635	.534	18.0
	Suffren	1899	411.75	70.25	27.5	12,527	.551	18.0
	Carnot	1894	382.25	70.5	27.25	11,964	.570	17.86
GERMANY	Braunschweig	1902	398.5	73.5	24.5	12,997	.634	18
	Wittelsbach	1900	393.75	68.25	24.75	11,640	.612	18
	Kaiser Wilhelm II	1897	377.25	66.75	25.5	10,974	.598	18
ITALY	Reginia Margherita	1901	426.5	78.25	27.25	13,214	.500	19.5
	Vittorio Emanuelo III.	1903	425.5	73.5	27.25	12,425	.498	22
JAPAN	Asahi	1899	400	75.25	27.25	15,200	.648	18
	Yashima	1896	374	73	26.5	12,320	.596	18.5
RUSSIA	Borodino	1901	367.5	76	26	13,600	.655	18
	Czarevitch	1901	388.75	76.25	26	12,912	.586	19.6
UNITED STATES	Connecticut	Probably 1904	450	76.83	24.5	16,000	.661	18
	Virginia	1904	435	76.2	23.75	14,948	.664	19
	Maine	1901	388	72.2	23.5	12,300	.654	18

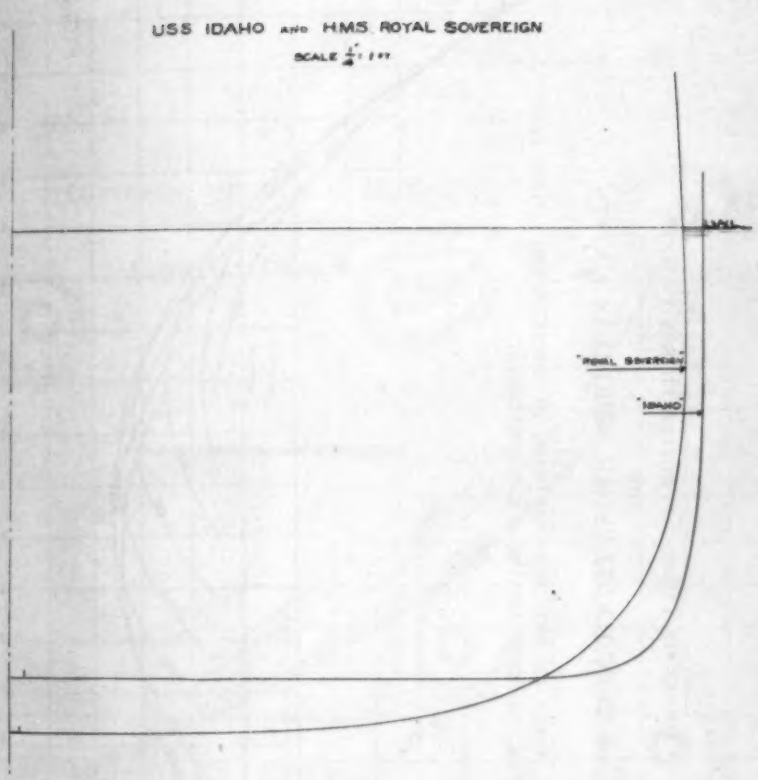
USS IDAHO AND H.M.S. ROYAL SOVEREIGN
SCALE 1/8" = 1 FT
LOAD
"ROYAL SOVEREIGN"
"IDAHO"

Fig. 1.

Curves of Total Effective Horse Power
for
16,000 TON BATTLESHIP, SPEED 18 KNOTS.

Constant length 450 feet; constant beam, 76 feet 10 inches. Mean draft and cylindrical coefficient varying as indicated below.

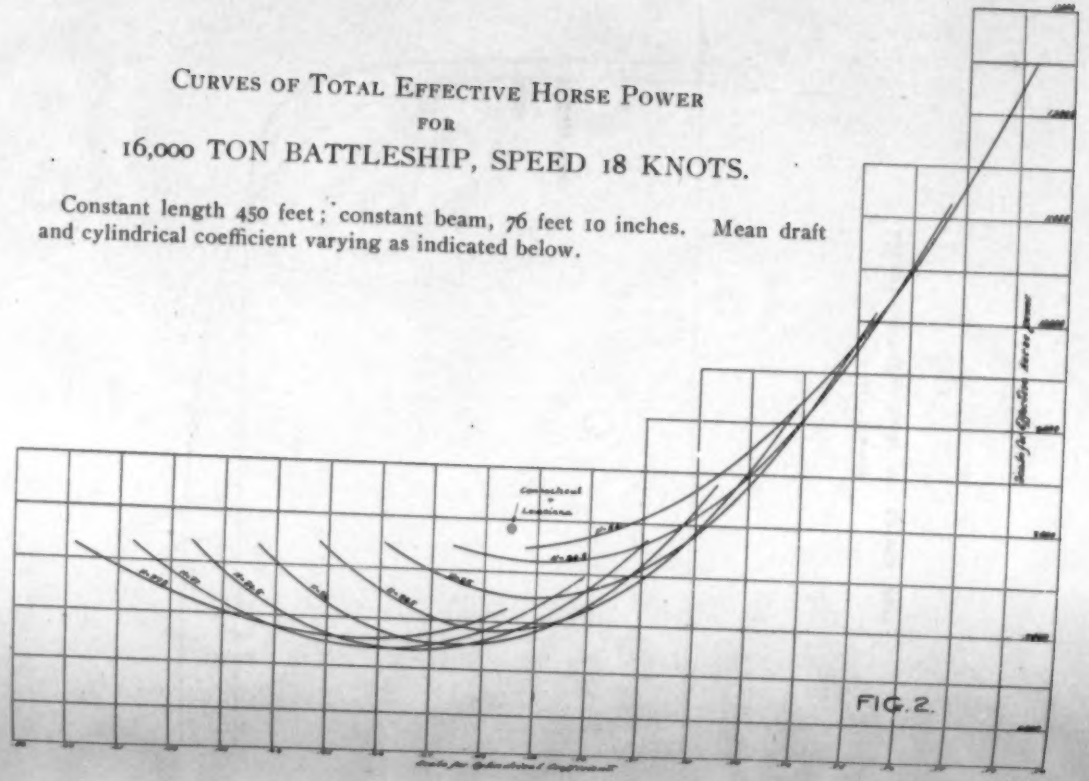

FIG. 2.

FIG. 2.

CURVES OF MINIMUM E. H. P.

FOR

CONSTANT DRAFTS.

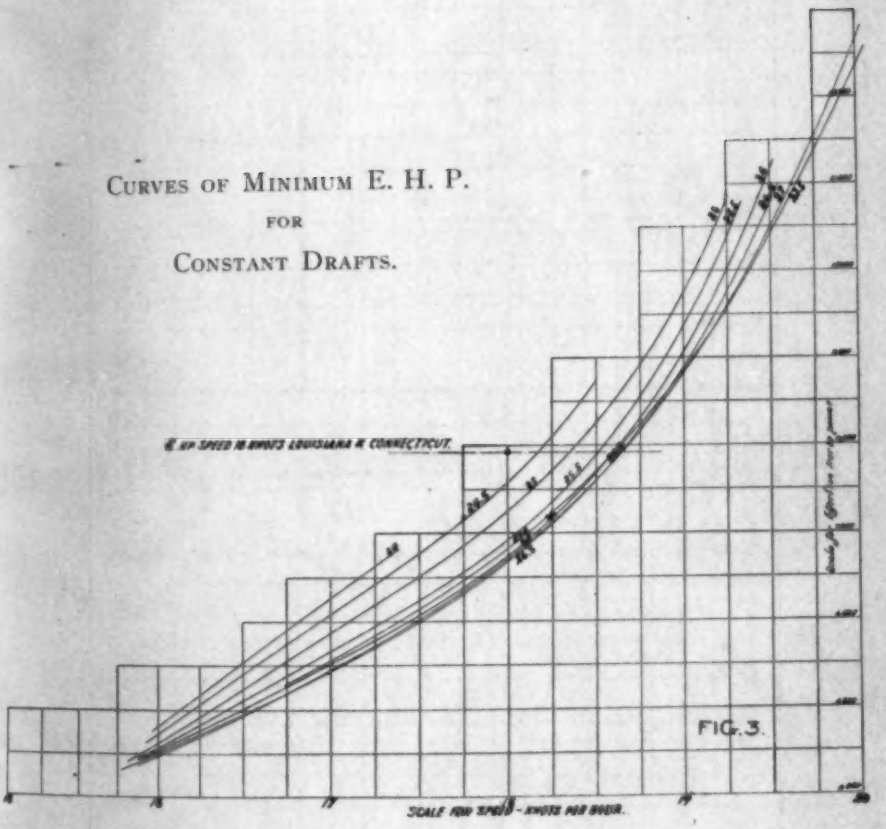

FIG. 3.

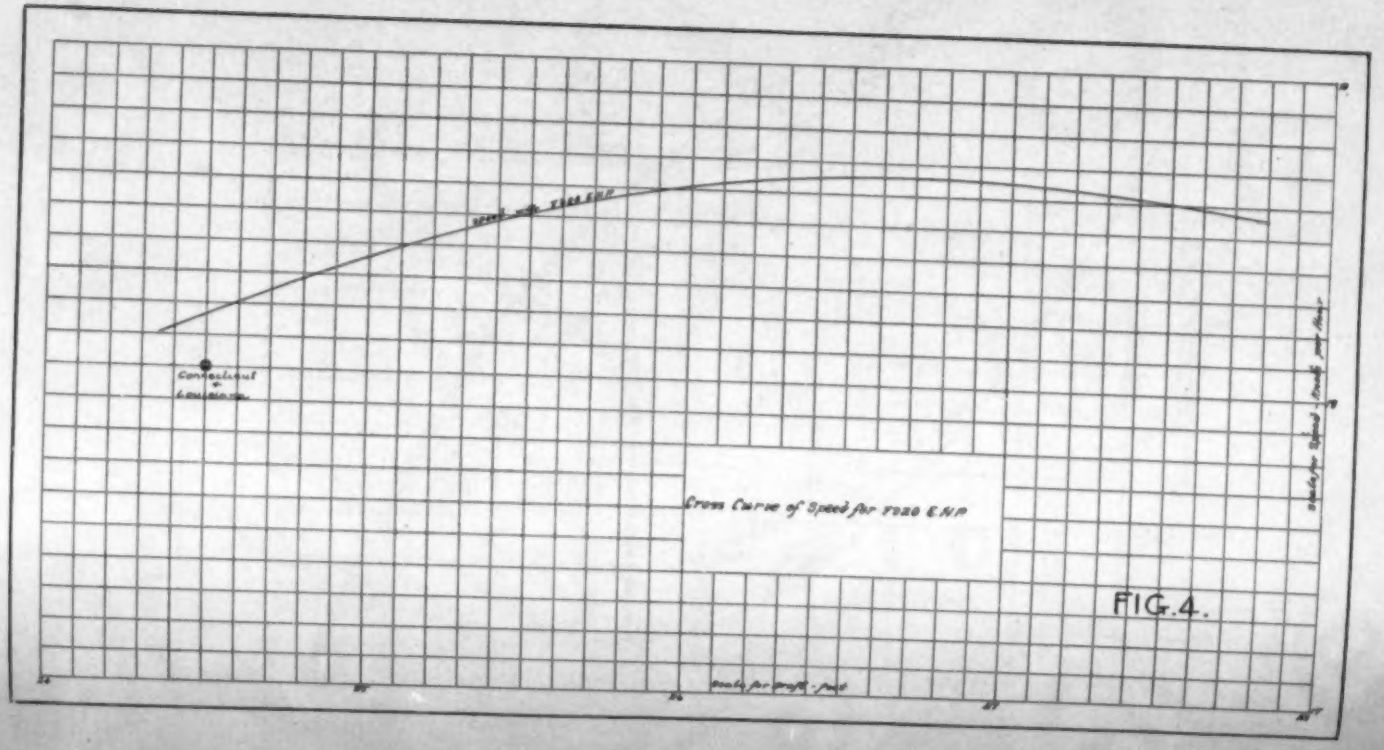

FIG. 4.

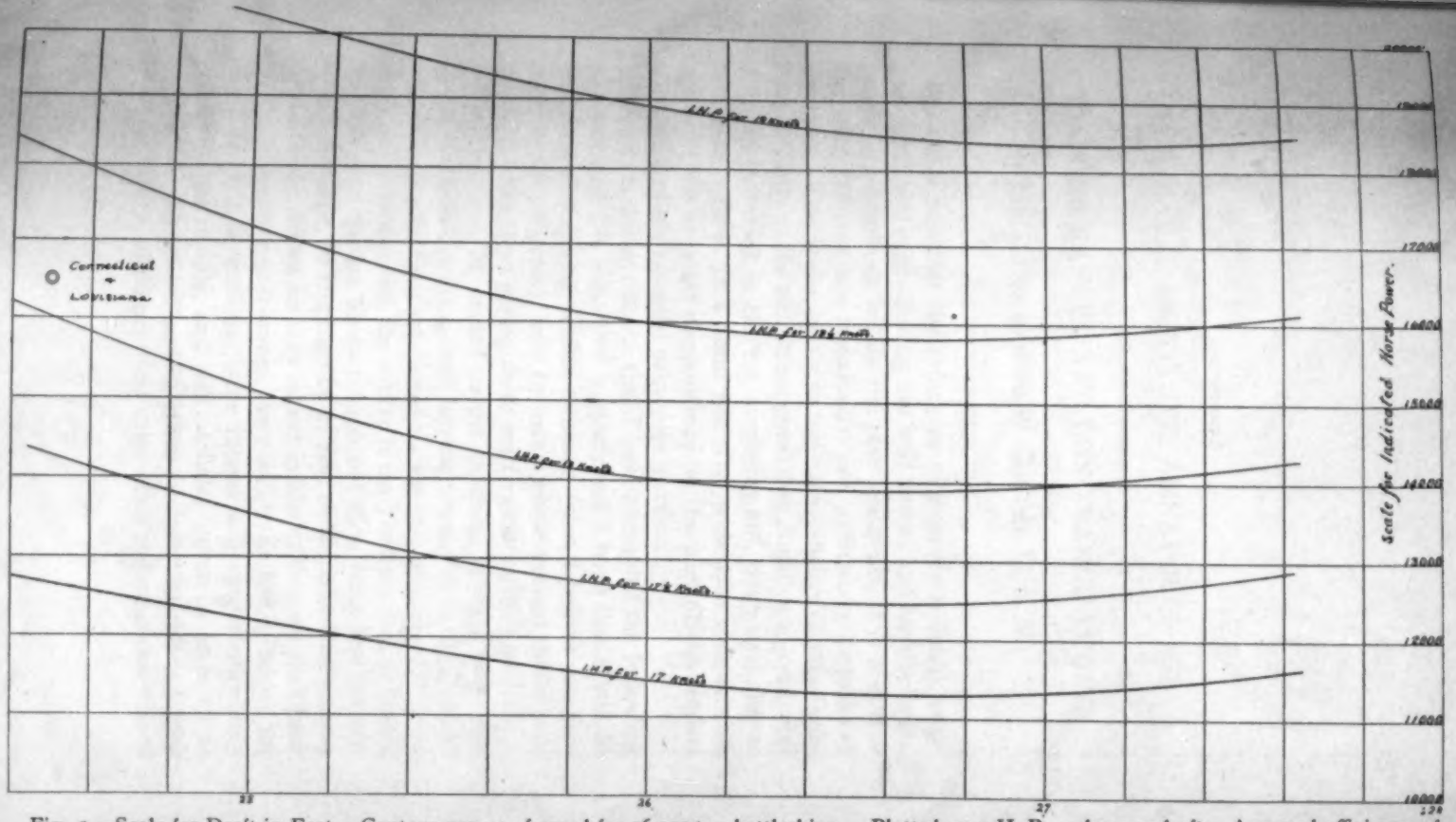

Fig. 5.—Scale for Draft in Feet.—Contour curves of speed for 16,000 ton battleships. Plotted on 1 H. P. and mean draft. Assumed efficiency of propulsion same as allowed for Connecticut design.

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TRAINING RANGES AND LONG-RANGE FIRING.

By LIEUT.-COMMANDER W. S. SIMS, U. S. N.

While it is true that the principles of gunnery training, long-range firing, and range-finding are well known and have been explained in publications within the past few years, it is also true that many officers are apparently not sufficiently acquainted with them. This is due partly to the inaccessibility of these publications, partly to the almost universal disinclination to read anything not contained in current numbers; but, doubtless, also to their being written in a form not always easy to comprehend, because of the assumed acquaintance on the part of the readers with certain of the essential principles involved.

It is for the above reasons that I have attempted the following explanation of this important subject; and I hope that it will be the means of changing certain opinions (that I believe are now impeding our progress), held by many whose present duties necessarily prevent them giving these matters close attention.

The conditions of record target practice, having been frequently published, are too well known to require a detailed description. The firing is conducted during fair weather, the speed of the ship is prescribed, the course is marked by a line of buoys, the limits of range are between 1400 and 1600 yards and the target is a rectangle, 17 feet high by 21 feet wide. Manifestly, these are not the conditions we may expect in battle; then we shall have to take the weather as it comes, there will be no line of buoys, the enemy will not be stationary, the ranges will vary continuously and sometimes rapidly, and will probably never be as small as 1600 yards. Therefore, certain critics declare that this is "trick shooting," and is of no practical value; that the range for record

practice should be largely increased; that the ships should fire in a sea way; that there should be no line of buoys; that the target should be under way, that ammunition should not be wasted upon cut-and-dried shooting, and, in a word, that all firing should be at battle practices, in order that our gunnery training may always be of a "practical" nature.

There are many other opinions that closely resemble those just quoted; and besides there is the persistent traditional opinion that the famous man behind the gun (the gun-pointer) should be a real marksman (not simply the man that points the gun), and should be trained to estimate the distance of the enemy, to observe the fall of his shot and correct the sight-bar setting accordingly, to allow for the change of bearing due to the speed of his ship and that of the enemy, to estimate and allow for the force of the wind, etc., etc.

The object of this paper is to show that such opinions, though formed in all honesty, are founded some upon misconceptions of the requirements indispensable to success in teaching men to *aim* accurately, and some upon certain mistaken facts.

It is admitted, of course, that the ultimate object of all gunnery training is that when we meet the enemy upon the sea, we may be able, no matter what the weather conditions, range, etc., to hit him more times per minute than he can hit us. It follows that any stage or any feature of the training that does not contribute directly to this result, may be either unnecessary, and therefore simply a waste of ammunition, or it may be false training, and perhaps dangerously misleading.

Before we can discuss profitably the question of proper methods of training pointers, we must first settle the fundamental principle upon which our system is to be based; that is, we must decide whether the man that fires the gun is to be trained as a gun-pointer, whose sole duty is to aim as ordered, or as a *marksman*, that is, a man that estimates the range, directs the setting of the sight, aims, fires, observes the effect of his shot, etc.

It goes without saying that if this could be successfully accomplished, the advantages would be very great, and the whole question of gunnery training would be simplified; for if the men that fire the guns could be trained to expertness as marksmen, in the same sense that a hunter is a marksman, the commanding officer of a man-of-war would need only to designate the target and give

the order: "You may fire when you're ready," and the duty of his divisional officers would consist in seeing their guns served with rapidity and safety. The advantages of such a system are so manifest that there could be no valid reason for not adopting it unless it could be shown to be quite impracticable. This therefore, is the first question to be settled, for, otherwise, the advocates of the different systems cannot advance beyond the stage of reflecting upon each others intelligence.

The whole question of the possibility of training a man as a successful great-gun marksman depends upon the possibility of training the human eye (either naked or using a telescope, and whether observing from a casemate, a turret, or an open gun-port—all relatively near the water) to estimate distances with sufficient accuracy to insure hitting—or, what will answer the same purpose, to estimate with sufficient accuracy the amount by which his shots miss his target. If distances up to about the maximum battle ranges can be estimated with accuracy by the eye, then it might be possible to train the pointer as a marksman—though even then it would be exceedingly difficult, as it would require a very cool and nimble brain to apply all the necessary corrections with sufficient rapidity and accuracy. If, on the contrary, the errors in estimating the distance are in the majority of cases so great as to render the method useless—that is, so great as to render hitting very improbable, then the traditional marksman is a myth, at least as applied to the conditions of modern gun-fire.

Fortunately, it is no longer a question of opinion, but of fact; and, as usual, it is a case of the familiar shield with different colored sides. From the time that great-guns were first used on board fighting ships, up to a comparatively recent date, the guns were so weak that ranges were necessarily very short, the vertical angle subtended by the enemy was consequently large, and the accuracy required to make hits was not great. In those days the pointer habitually estimated the distance of the enemy with considerable success. In some cases he made his estimates by an unconscious method depending upon the quality of the so-called "nautical eye," which, we are informed, is no longer found in the theoretical heads of those who have never really acquired the "sea habit." Sometimes the method was more scientific, if not more successful. When all men on the enemy's decks looked alike, the

range was 1000 yards, or over; at 800 yards you could distinguish a man from an officer; at 600 yards you could make out a pair of well-developed side whiskers; at 400 yards you could hear the men swearing; and so on down to the range at which you could see the whites of their eyes. The traditional pointer made his allowance for range by selecting his point of aim, the topsail yard being a favorite. He was the Captain of his gun, and he did not want advice from anybody.

Since the introduction of rifled guns of high velocity, and the consequent increase in fighting ranges, all this is changed—except the opinions above indicated. As a matter of fact, it has been demonstrated by exhaustive experiments that it is quite impossible for the eye to estimate distances greater than about 2000 yards with anything like sufficient accuracy to be of use in directing gun-fire. For example, the following conclusions derived from a test made by about 30 observers (one-third being experienced officers and the remainder principally gun-pointers) will show the futility of such a method.

"(1) The estimates are so wild as almost to preclude laying down any laws or drawing any conclusions. The averages of errors, however, compare favorably, increasing with an increase of range, as would be expected, and from these averages certain deductions may be drawn.

"(2) The probable error on a single estimate at any range is so uncertain as to be worthless for any gunnery purposes. At 1193 yards, when the vessels were broadside on, 19 out of 20 observers on the battleship, and 4 out of 6 observers on the torpedo boat estimated the range within one-half of the danger space of a 20 foot target, but even at this short range there was a variation of 1200 yards between extreme estimates; and later on, at the same range, with vessels end-on, the number of these same observers who estimated within one-half of the danger space of the target were reduced, respectively, to 8 and 3, and the extreme limits of variation of estimates rose to 2400 yards, showing the great effect of the difference of conditions of position alone on estimates made by the same men.

"(3) Beyond 2100 yards, in no case did more than 1 observer on each vessel estimate within one-half of the danger space of a 20-foot target. Between 2000 and 2100 the number who estimated with this degree of accuracy were, battle ship 5; torpedo

boat 2; but it must be noted that the observers who estimated with this degree of accuracy, say at 2100 yards, would not be the ones who did it at 2000 or 2095 yards, thus showing the mere chance of the estimates, and the futility of ever counting on this method of range-finding in action."

(The half danger spaces above referred to are those of the 6-inch 40-calibre gun, I. V. 2400 f. s., which are about as follows: 260 yards at 1200, 140 at 2000, 75 at 3000, 45 at 4000, 30 at 5000, and 20 at 6000. For comparison, the half danger space of the 12-inch 40-calibre gun, I. V. 2800 f. s., is as follows: 395 yards at 1200, 230 at 2000, 140 at 3000, 100 at 4000, 70 at 5000, and 55 at 6000.)

If anything further is needed to demonstrate the uselessness of attempting to train a modern pointer as a marksman, the results of similar and equally conclusive tests show that, even if the pointer were able to estimate the amount that his shots fall short, it would be, in the great majority of cases, impossible for him to identify his own shots, when a number of guns were firing at the same time, because the smoke and gases from his own and from adjacent guns very seldom permit him to observe his projectiles throughout their flight, though his opportunities for aiming and firing may be very frequent.

Assuming, therefore, that the pointer is to be trained simply to point his gun as directed, and that his sight will be set by direction of skilled range-officers advantageously placed for observing, it remains to discuss the means by which we can *train* pointers, in the shortest space of time, and with the least expenditure of ammunition, to such a degree of expertness that they may be *depended upon* always to point their guns quickly and with unfailing accuracy.

It is, of course, not proposed to give a detailed description of these methods, but simply to determine, if possible, the conditions that are indispensable to success in *training* a man to *aim* with accuracy, the requirements of a method that will test fairly his skill and his nerve, and the rational way of employing the pointers after they have achieved expertness.

Before proceeding with the exposition of the simple principles involved, I feel that almost an apology is due for the elementary nature of some of the following explanations and illustrations; but I believe that they may be useful in dislodging certain sin-

gularly tenacious opinions held by men of influence who have apparently not taken the pains to analyze the basis of their convictions.

It will at once be admitted that no real progress could be made in *training* a recruit unless you use a gun that is accurate enough to make a hit every time it is accurately aimed. This applies, of course, to sub-calibre practice of any kind. For example, suppose your sub-calibre tube is an old-fashioned blunderbuss that cannot be depended upon to make one hit out of 10 shots on a target of a certain size at a certain range, even if the gun and the target are solidly planted on shore, and the gun is accurately aimed by an expert. Manifestly, any attempt to *train* a recruit with such a machine would be a waste of ammunition, not to mention your time and his; for when the recruit fires and makes a miss, he learns nothing by the experience. If, however, you substitute a modern rifled tube that can be depended upon to hit every time when accurately aimed, then when the recruit fires and misses, he has learned something; he knows, in the first place, that the fault was his and not the gun's, and the position of the miss, with reference to his supposed point of aim, shows him where he made his error in aiming.

The principle involved is that, for efficiency in training pointers to aim, the conditions must be such that the gun will make a hit in the bull's-eye *every time* it is accurately aimed thereat; in other words, that the shot and the line of sight will always pierce the target in practically the same place. I say in "practically" the same place, because no gun is absolutely accurate, no matter how short the range. The point is that the range must be short enough and the target large enough to ensure a hit every time the gun is accurately aimed. This is the gist of the whole matter, and its very simplicity is possibly the reason of its being so persistently misunderstood. Therefore, at the risk of being tedious, I will further illustrate it as follows:

Suppose you secure a modern, high-powered, .30-calibre rifle in a heavy vise in such a manner that it will not be deranged in the least by the shock of discharge; and suppose the line of sight to be directed at the middle of a screen placed at a distance of, say, 300 yards. Fire a few shots, and you will probably find that no two of them have pierced the screen at the same point. The best cartridges differ slightly in power from each other, the bul-

lets are not absolutely uniform in shape, weight and position of centre of gravity, there are slight differences in the way they "take" the rifling, the latter is not perfect, etc., etc. I assume all other causes of deflection to be eliminated, as, for example, the effect of wind, etc. If, therefore, you fire 1000 shots, you will find that the holes in the screen are distributed about uniformly over a certain area. Draw a line around these holes, including all of them, and you will find that the figure is nearly a circle (more nearly an ellipse, I believe) of a certain diameter, say 4 inches. If you fire a second string of 1000 shots, with the same quality of ammunition and under the same conditions, they will all fall within this circle.

Similarly, a "perfect shot" who aims exactly at the center of this circle will make a hit every time he fires. Of course a perfect shot does not exist; no man can train his muscles to such a degree of refinement as to hold a rifle perfectly still. Experience shows, however, that a man can be trained so that his line of sight will not vary from the point of aim more than a certain amount. Suppose this amount to be such that the line of sight remains within a circle 4 inches in diameter on the screen at 300 yards. Such a man we will call a "good shot." Then, if the diameter of the circle enclosing the shot holes be increased from 4 to 8 inches, it is evident that a "good shot" could hit this bull's-eye, 8 inches in diameter, every time. Therefore, in order to train men (using this gun and ammunition) to *aim accurately*, the relation between the size of the bull's-eye and the range at which it it used, should be as 8 inches is to 300 yards (for ranges not differing much from 300 yards). If the range is reduced to 150 yards, the diameter of the bull's-eye should be something less than 4 inches; similarly, if the range is increased to 600 yards, the bull's-eye should be somewhat more than twice as great as at 300 yards. As a matter of fact, it is made 2.5 times as great for 600 yards, or six times as great in area. (The diameters of the bull's-eyes of regulation army targets are as follows: 8 inches for 200 and 300 yards, 20 inches for 500 and 600 yards, and 36 inches for 900 and 1000 yards.) Neglecting for the sake of simplicity of explanation, all causes of error except those above mentioned, we see, therefore, that a "good shot" can hit with equal facility at any of the three ranges indicated, provided the diameter of the bull's-eye bears a certain necessary relation to the range.

For the remainder of this illustration, I assume the bull's-eye to be used as the target—that is, the bull's-eye alone, not surrounded by a screen that will show the amount by which shots miss it, as is the case with the regulation Army target. The reason for this assumption will be shown later when an essential feature of great-gun targets is explained.

If, then, such a bull's-eye target is made much too large (to put the extreme case, suppose it to be 10 feet in diameter), a man need not be a "good shot" to hit; therefore a green man cannot be trained to expertness by the use of it. If, on the contrary the target is much to small (say one inch in diameter), it is almost entirely useless to attempt to train him to expertness by firing at it. For example, suppose that the 8-inch bull's-eye is used as a target at 600 yards, instead of the 20-inch one. As the former is but one-sixth of the area that it should be at this range (600 yards), it is evident that even the "good shot" cannot expect to hit it more than once in six shots, on an average. Therefore, to attempt *to train a green man* by using the 8-inch bull's-eye as a target at 600 yards is largely a waste of time and ammunition.

The above, will, I believe, make it clear, that for purposes of *training a pointer to aim accurately*, or *as a test of his acquired accuracy*, the size of the target must bear a certain definite relation to the range—depending both upon the unavoidable errors of the gun used and upon the normal error in aiming of "good shots." It follows that if the target is reduced in the proper proportion, a very short range may be used with equal advantages, as far as concerns training a man in *accuracy of aiming alone*, which, of course, must first be attained before any further progress is possible. For example, a man can be trained to aim accurately by practicing at a range of less than 50 yards, provided the target is reduced in size to correspond therewith; or by placing a small, 22-calibre tube in a rifle, he may practice with advantage at 50 feet, or less. Most officers are familiar with this principle, and with its important application.

It may be replied that if the above is true, there would apparently be no reason for training riflemen at long ranges; and this would be true if the fire of riflemen could always be controlled in battle in the same manner and with the same efficiency as that of a number of heavy guns firing from the same position—grouped on the same ship. The frequent necessity for independ-

ent action on the part of the rifleman forbids this, to a large extent. Therefore the rifleman must be trained as a *marksman*. He must have the skill of the big-game hunter in estimating the distance, setting the sight, allowing for wind, etc., when firing at long ranges. In order to give him this skill, he must be trained by actually firing at long ranges—but each range must have a target of the proper size, otherwise the firing is not a training.

If the fire of riflemen could, upon all occasions, be controlled by their officers much more effectively than is now possible by the best riflemen acting independently, it would be advisable to train them as accurate pointers only, and not as marksmen. Battle firing at long unmarked ranges is, necessarily, not very accurate, even under favorable conditions. The average of shots fired to men killed is very great.

The principle of the proper relation between the range and the size of the target necessary for successful training applies to all calibre of guns from .30-calibre rifles to 13-inch turret guns; and, for certain calibres of naval guns, the dispersion of accurately aimed shots has been obtained by actual firing on shore against a screen target. Experience in firing guns of different types mounted on board ship has supplied similar, though less accurate, information. It is from a consideration of such data that the relation between the record-practice range and the size of the target has been determined. It would, of course, be desirable to have a different sized target for each calibre of gun that fires at the same range, but as this is impracticable, the target is made large enough to include all the unavoidable errors of any of the guns that use it. (For reasons that need not be stated here, we continue to fire some guns on the 1000 yard range when a consideration of their ballistic qualities alone would assign them to a longer range). Thus, the target for all guns above 3-inches in calibre is 17 feet high by 21 feet long, and the range is 1400 to 1600 yards.

This target is larger than would be necessary to catch all shots that are aimed with perfect accuracy and fired at a distance that is exactly known—which would be the conditions existing if the gun and target were on shore. But when firing at sea, perfect accuracy in aiming cannot often be attained, and there is always more or less error in the range; therefore the screen must be en-

larged accordingly. It may be a trifle too small for some conditions of sea firing and a trifle too large for others, but this is not apparent from the results of firing under the condition of record practice. For convenience of illustration, it will therefore be assumed to be of exactly the correct size for the gun in question, when firing at 1600 yards.

Note that the entire area of this target (assuming it to be the correct size) corresponds to the bull's-eye of a rifle target, and the so-called "bull's-eye" (51 inches square) that is painted in the middle of the 17 by 21 rectangle, corresponds to the 4-inch circle, mentioned above in connection with the 8-inch bull's-eye of the small-arm target used at 300 yards. In one case, the rifleman (the "good shot") is supposed to keep his line of sight within a 4-inch circle, at 300 yards; and in the other case, the gun-pointer (also a "good shot") must not aim outside of the 51-inch square, if he wants to be *sure* of making a hit. Of course it would be a great convenience in spotting misses, if we could use a very large great-gun target, say, 60 feet square, with the present target (17 by 21) painted in the middle of it, and hits on the latter only to count; but such targets would be impracticable to handle, not to mention the expense of mounting them.

The requirement that the great-gun pointer shall aim within the 51-inch square (assuming this to be the proper size for the aiming spot) refers to firing under the conditions of record practice. These limits are necessary on account of the difficulty of holding the line of sight steadily within them during the "firing interval," while the ship has a certain amount of motion; of course with a naval gun and target on shore, an entirely unskilled person can place the wires on any indicated point, within a few inches.

Record "target practice" is a misnomer which we have inherited from the past, but which it would be inadvisable to change at this time. It is, in reality, principally a "firing test" to determine the actual skill of the pointers and gun-crews. Before it begins, a division officer knows almost exactly the relative accuracy and rapidity with which his various pointers can aim, but in the case of untried pointers, he does not know whether or not they will show the necessary nerve and steadiness under the excitement of firing. Sometimes he is disappointed to find that an otherwise excellent pointer gets "rattled"; but there is one thing that both he and all of his pointers understand thoroughly, namely,

that a hit will be made every time that the gun is accurately aimed and no mistakes are made in ranges, etc.; that the target is large enough to include all of the errors of gun-fire afloat, that cannot be avoided by any precautions on their part, such as differences in the initial velocity of different charges, etc., etc. In other words, the relation between the range and the size of the target is such that all hands know that the result of the shooting is a fair comparative test of the skill of the personnel, and that success does not depend upon luck; hence the intensity of loyal competition, without which only indifferent success can be attained in gunnery training, or in any other training requiring skill and dexterity.

As far as concerns training alone, there would be no objection to doubling the present range, provided the target were made just large enough to catch all well-aimed shots. For most guns, this would probably require a screen somewhat more than twice as high and twice as wide, or more than four times as great in area as the present one. To hold up the present screen (17 by 21) in a moderate breeze, requires a target raft weighing 6 tons, and 700-lb anchors with 3½-inch mooring lines; so it may be imagined what gear would be necessary to carry more than four times as much sail; and in many respects the result of the firing would be less satisfactory than under the present condition,—not to mention the increased difficulties of spotting and of handling heavier screens, the longer distances to be travelled by the ship and the repair boat, and the consequent loss of time, etc.

If the present target were used at 3200 yards, the best pointers could not make more than about one hit out of four shots, under the ordinary conditions of practice, and, consequently, the firing would not be a true test of skill; the element of luck would enter so largely into the result that the spirit of competition would disappear, and with it the efficiency of team-work and the skill of the pointer.

Firing under such conditions would be, in effect, the same as using the blunderbuss to test the skill of a rifleman. As an instrument for training pointers, the very best gun becomes a blunderbuss when the range is much too great or the target much too small. Many years ago, all of our target practice was exclusively blunderbuss training. We fired at a small triangular target (about one-seventh the area of the present one) that a perfect

pointer could not hit once out of many shots. Consequently, we did not expect to hit it. We estimated the amount by which a pointer missed this target, and we now know these estimates to have been greatly in error. Unless the misses were very wide, we were quite satisfied. We had to be, for there was no standard with which the accuracy of a shot could be compared. The consequence was that the pointers learned almost nothing. To double the present range without doubling the size of the target, which is impracticable (as well as useless), would be to reproduce the blunderbuss training of the past in all the essential particulars that rendered it largely a waste of ammunition.

It is therefore apparent that in order to *train the individual pointer* and test the effectiveness of his training, we must fire at about the present range (1600) as long as we use a target of the present size (17 x 21). In any event, we must always maintain a certain definite relation between the size of the target and the range at which it is used. In all cases where this relation pertains, it would be convenient to call it a "training range."

I am aware that, for this year's prize firing, the British have changed the range from 1600 to 2700 yards, but they have not thereby changed the principles involved. They have increased the area of the target somewhat, but if they have not given it the size necessary to insure a hit for every shot that is well aimed, the consequence will be that the result of their prize firing of 1904 will not be a true test of the skill of the pointers, and the efficiency of the training of the latter must inevitably suffer.

We all know that we can train gun-crews and gun-pointers to a high degree of skill—this skill being measured by firing under the conditions of record practice. "But," object the critics, "of what use are such pointers if they cannot make a large percentage of hits at long range?" "Why do we waste ammunition on 'fool shooting' at 1600 yards when we should be teaching our pointers to make 60% of hits on an enemy at 5000 or 6000 yards?" "What is the sense in conducting practice always under favorable conditions when we may have to fight an enemy in an ocean swell?" etc., etc.

I beg that it will not be assumed that these questions represent straw men that I have set up in order to demolish them. They are actual questions propounded, not in the winning spirit of the seeker after useful information, but with a marked elevation of

one side of the lip, a habit peculiar to the unthinking. The confusion of thought indicated by such questions may be shown by a few simple illustrations.

A perfect pointer, firing a perfect gun, with the sight-bar correctly set, could put every shot through a bull's-eye, equal to the diameter of the projectile, at any distance up to the maximum range of the gun. Even the critics know this, but they greatly underestimate the influence of the errors involved when they insist that a system of training is not a practical one unless the pointer can eventually make a large percentage of hits at a long range.

In principle the matter is so simple that it would seem that all differences of opinion should disappear with a careful consideration of the facts.

When a great gun is fired at a target at a considerable range, there are a dozen or so different errors that may contribute to decrease the possible percentage of hits. It will not be necessary to consider all of these individually, in order to illustrate the combined influence of certain errors in decreasing hits at all ranges that are greater than the "training range,"—that is, greater than the maximum range at which a good shot can make a clean string of hits on the target used. For the sake of simplicity, only errors in range will be considered.

Though the charges of smokeless powder are made up at a proving ground with all possible care, it is found that even those of the same index will vary in initial velocity from 15 to 25 foot-seconds from the desired velocity. Thus the extreme variation of one of these charges from another may be from 30 to 50 foot-seconds. The temperature at which they are fired may increase or decrease this variation. The powder sometimes becomes irregular with age. The weight of the shell or the diameter of the rotating band, may change the range appreciably. Usually the effect of such errors cannot be anticipated and allowed for by the personnel on board ship. They are commonly called the "unavoidable errors" of the gun. Suppose that, with a certain gun firing at 1600 yards, their maximum effect, when they all act in the same direction, is to displace the shot four feet vertically, either up or down from the point of aim. If such a gun were mounted on shore, and each shot accurately aimed at the center of a screen, this screen would have to be eight feet high in order to catch all shots fired at its center. Therefore, if the same screen is placed

at 3200 yards from the gun, it is evident that more than half of a large number of shots will miss it—going either too high or too low—and at 6000 yards, more than two-thirds will miss it; and these misses, being due to the "unavoidable errors" of the gun, cannot possibly be diminished, except by diminishing the errors. That is, if a pointer could be trained to absolute perfection, it would be entirely impossible for him to avoid making the percentages of misses indicated, while using the gun in question, at this range.

Now suppose the gun described above to be fired from a ship's deck, at the same range (1600), under the usual conditions, i. e., aimed and fired rapidly in fair weather. Several additional errors are at once introduced. The pointer is not perfect. The best he can do is to keep his aim within a certain distance of the center of the target, the range is not very accurately determined, even when marked by buoys; the sights are inevitably somewhat out of adjustment; the jump of the gun varies sometimes according to the angle (from abeam) at which the gun is fired, etc., etc. Suppose that these additional errors, when acting in the same direction, amount to 4.5 feet, either up or down. The "unavoidable errors" of gun-fire (with this particular type of gun) on ship board are, therefore, 4.5 feet, either way, consequently the target must be 9 feet higher, or 17 feet in all to catch all shots. In other words, when a 17-foot target is used for this gun, the proper "training range" is 1600 yards. No attempt at exact accuracy is made in the figures used—they are assumed for purposes of illustration only.

It is evident, therefore, that with a ship anchored in fair weather, the range known within narrow limits, and the gun fired by a good pointer, it is possible to hit the target every time only when the range is 1600 yards or less (supposing the figures assumed to be correct). If the range is doubled, then less than half the number of hits can be made. It is simply impossible to make, on an average, more than 50% of hits on this target, at this range, and with the unavoidable errors assumed. No amount of training can improve the results appreciably, as I have assumed the pointing to be done by one of the most expert pointers (whose error in aiming is assumed to be very small), and all the other errors are unavoidable with the gun in question. The percentage of hits at this range (with this gun) can be increased only by more uni-

form powder, more accurate sights, more accurate methods of determining range, etc.

This should dispose at once of the astonishing opinions one frequently hears expressed, to the effect that a large percentage of hits should be made at long ranges, when the fire-control system is sufficiently improved and the *pointers become expert at those ranges*—the assumption being that when we can determine the range accurately, the pointers should hit every time.

Thirty-two hundred yards is not a very long range. If the screen in question is placed at 6000 yards, it is evident that less than one-third of the shots will hit. As a matter of fact, very much less than one-third will hit, as the dispersion of the shots becomes greater with the range, which must be known within much narrower limits in order to make a hit, even with a gun free from error, because the danger space of the target at a long range is relatively very small. Knowing the maximum errors of pointing, the errors in range of the guns, etc., the probability of hitting could be calculated for this range, but as this paper concerns only the principles involved, this is not necessary. It may be assumed, however, that at 6000 yards the probability of hitting under the conditions in question (a ship at anchor, etc.), would not be greater than one hit in six shots. Therefore the maximum that the best pointers could do under the very best conditions, with this gun, is 100% at 1600; 40%, say, at 3200 yards, and 16% at 6000 yards; and this will be considerably diminished, especially at long ranges, by lateral misses.

Nor is this all; for when you come to practice shooting at a towing target, from a moving ship, the most fruitful source of error is in keeping the range. As an example, take the conditions at 6000 yards. The danger space of the target is, say, 50 yards, i. e., a shot that just misses the top of the target will strike 50 yards beyond. You must therefore know the actual distance (or correct sight-bar range) within 25 yards in order to hit every time with an *errorless gun;* and the best range-finders have an error of over 100 yards at this range. Therefore, with both an *errorless gun and an errorless pointer* the chances of hitting are very small. Add to this all the unavoidable errors of gun-fire and of aiming at sea, and it requires no calculation to see that the maximum possible hits on a target 17 feet high at 6000 yards would be exceedingly small.

Previous explanations have shown, I believe, that it would be absurd to attempt to *train* green men by firing at a 17 foot target at 3200 or 6000 yards, but that, with this target, the 1600 yard range fulfils approximately the requirements for training a man to aim accurately, and for testing the results achieved. With permanence in gun stations we can doubtless bring up the general average of our pointers and thereby increase our efficiency, but there is a limit to the degree of skill to which a man's muscles can be trained in handling a heavy gun. For purposes of illustration suppose that the best pointers can aim within a bull's-eye, or aiming spot, 4 feet in diameter at 1600 yards. That is to say, the angular variation of the line of sight from the center of the bull's-eye, while aiming, is not more than 2 feet, or 1 min. 35 sec. of arc. Improvements in gun-gear and sights may enable us to reduce this somewhat; but let us suppose this to be the least variation at present attainable under moderately favorable weather conditions.

As this angular variation of the line of sight will be the same at all ranges, it follows that the longer the range the greater the vertical error in the fall of the shot, due to the error in aiming. For example, under the conditions assumed, this error is 2 feet at 1600, 4 feet at 3200, and 7.5 feet at 6000 yards. That is to say, the vertical dispersion of shots, fired by the most skillful pointer will be 4, 8 and 15 feet, respectively, at 1600, 3200 and 6000 yards; and still those who will not take the trouble to reason out these simple propositions, have shown themselves ready to condemn all systems of training pointers, or of controlling gun-fire, that do not produce as great, or nearly as great, a percentage of hits at a long range as at a relatively short one.

When the pointers have been trained to such a degree of skill that they can make a very large percentage of hits at the training range, under the favorable conditions prescribed for record practice, they have demonstrated their fitness for further training under less favorable conditions. To exercise them at the latter before they have achieved reasonable expertness at the former, would be as unjustifiable a waste of ammunition as to exercise green riflemen at long ranges before they could hit the standard small-arm target at 200 yards.

When the conditions are unfavorable, the shooting will be neither so rapid nor so accurate, but when pointers have attained their maximum efficiency under unfavorable conditions, their edu-

cation is finished. They are ready to render us the best possible service in hitting an enemy under any conditions when they have been so trained that we can depend upon them to aim always as directed, and always with the maximum accuracy to which men can be trained to aim under the various conditions in which shooting is possible.

Such pointers will make the maximum number of hits that can be made under the circumstances—the circumstances being (1) the unavoidable errors in aiming of the best pointer, under the weather conditions existing at the time; (2) the unavoidable errors of their guns (sights, powder, etc.); and (3) the accuracy with which we, their officers, can keep the range and set their sight-bars.

Better than this no pointer can do (until more accurate means are invented), and it necessarily follows from the above, that such pointers, trained at "fool shooting" on the training range, will render us better service, no matter what the conditions under which the enemy is met, than pointers trained by any other system in which the accuracy and reliability of the pointers is not the prime object.

If it were possible to rig mechanical appliances that would at all times automatically keep the line of sight exactly on the center of a target, we would then have ideal pointers, and could dispense with human ones. With such aiming appliances, and a perfectly accurate range finder, we would have no errors to contend with except those due to the gun (sights, powder, etc., etc.); but these are so considerable at long ranges, and the danger space is so small, that few hits could be made. Simple as this is, it is constantly being lost sight of; and it is important that it be clearly understood, otherwise the extent of the inevitable errors of long-range firing will be seriously misapprehended, and the consequence will be disappointment and dissatisfaction with the pointers, even though they be practically perfect, and distrust of the system of training. The following example will, I believe, make this point clear:

Suppose that at a certain long range, the danger space of a vertical screen target is 40 yards. Then, with a perfect pointer aiming at the bull's-eye, a perfect range finder and an errorless gun, all shots would pass through the center of the target, and would strike the water 20 yards beyond. Now suppose the gun's errors

in range, due to powder, etc., to be such as to cause shots to fall anywhere between 100 yards short and 100 yards beyond the point of impact of a shot passing through the center of the target. Evidently, the chances of hitting would be as 40 is to 200, or one in five; and these chances cannot possibly be increased by any refinements of training or of range-finding, since we have assumed these to be perfect.

To many readers these principles will appear so self-evident that I am sure many will suspect me of amusing myself by demolishing straw men, but such is not the case. Actual statements are made, with evidently sincere conviction, substantially as follows: "I have known pointers that could estimate the range at 6000 yards within a few yards, and make a hit nearly every time; and that's what we should be doing now instead of wasting ammunition in this manner."

Many of the persons who made such statements enjoy such a high reputation for ability that those who suffer from chronic cerebral inactivity have accepted them without question; and such "opinions" have doubtless influenced writers of reputation to make similar statements in deliberate articles and sell them to responsible publications. For example, in the Outlook for July, 1904, Mr. James Barnes, in an article entitled: "The Battle off the Capes" ("part of a stirring romance with that title by Mr. Barnes—a book, as he expresses it, which deals with 'possible history'") describes an imaginary naval action in which occurs the following "possible history" (the italics and parenthesis are mine):

"The *Washington* swung in a little closer to the black line of the English fleet, but not one gun was fired at her. Both sides seemed paralyzed, shocked, half dismayed into forgetfulness of action (by the spontaneous explosion of a whole fleet of submarines—an entire impossibility, but very effective for dramatic purposes). Then with a crash, the Englishman broad off the beam of the *Washington* opened (fire). Black specks, whirled in the air from the grand old battleship's decks. She almost staggered under the blows that reached her, *for the lines* (of vessels) *were now but little more than six miles apart.*"

"Naval experts had said that they could not have approached that near without losing ships on both sides." . . .

"A bugle rang out. The bridge beneath their feet, as they

started for the ladder, leapt and trembled. Emery saw the projectile plainly as it soared out in its flight. He paused a second (it takes a 12-inch projectile 19 seconds and a 6-inch projectile 27 seconds to go 6 miles) to watch the projectile, then—'Good shot, he cried, straight into her!' The young lad in the top screamed out shrilly, repeating the words as in joy: 'Hurray, good shot!'"

This is "stirring romance" all right, but it certainly is not "possible history." The projectiles of our most powerful 12-inch guns have an angle of fall of about 11½ degrees at 6 miles, therefore the danger space of a battleship, say, 40 feet high, is about 66 yards. Therefore in order to make a hit, with a perfect gun and perfect aiming, the range must be known within one-half this amount. The best range finders are almost useless at such a distance. The error is certainly not less than 5 per cent, or 600 yards. The dispersion of the shot in range, due to difference in powder charges, etc., would be at least 200 yards either way. Therefore, assuming the aiming to be perfect, the chances of hitting would be about as 33 is to 1600, or one hit in 48 shots—and each 12-inch gun is supplied with not more than 60 shells. Manifestly, this is not sufficiently stirring for the purposes of romance. As the projectiles of the most powerful 6-inch guns have an angle of fall of over 27 degrees at 6 miles, the range must be known within 13 yards in order to hit, and the chances of hitting with this gun are less than half that of the 12-inch gun. Under these circumstances it is evident that anything like the traditional storm of projectiles that make shambles of a ship's decks, at a distance of 6 miles, is pure "romance," though doubtless "stirring" enough for those who do not know better.

As for the appliance by which Mr. Emery, of the U. S. S. Washington, and the "young lad in the top," were enabled to follow the flight of a 12-inch projectile for a distance of 6 miles, and assure their anxious Captain that it went "straight into her," I may say, confidentially, that such an appliance, securely protected by patents, is worth millions.

SUMMARY OF CONCLUSIONS.

1. Great-gun pointers cannot be trained to be efficient *marksmen;* and if this could be done, we could not utilize their skill on account of the impossibility of their being able to identify the

splash of their own shots when many guns are firing, because this requires an *uninterrupted* view of the projectile during its entire flight; which can be obtained only from a comparatively elevated position, well above the smoke and hot gases from the guns.

2. Given a certain gun, in order to train pointers to the highest possible expertness in aiming, or in order to test the expertness they have achieved, firing on a training range is essential; that is, a range which bears such a relation to the size of the target used that a "good pointer" can hit it every time, notwithstanding all unavoidable errors.

3. When the same target is used at a much greater distance than the training range, as above defined, the shooting is not a training for the pointer—it is blunderbuss training.

4. Having trained pointers to the highest expertness in aiming that experience shows to be possible at present, they can be utilized at any range to make the greatest possible percentage of hits that the range (angle of fall), the unavoidable errors of the gun, and the conditions of the firing will permit—provided, of course, the range-finding is efficient.

5. The three principal causes of missing are (*a*) errors of pointing, (*b*) unavoidable errors of gun-fire at sea (due to powder, etc.), and (*c*) errors in establishing the range.

6. Of these, the first (the error of pointing) is by far the least; and if it could be entirely eliminated, the difficulties of hitting at long ranges would be but slightly decreased.

7. As the present skill of the best pointers is such that no very considerable improvement in aiming is possible, it follows that the effectiveness of gun-fire at sea can be materially increased only by more accurate methods of finding, and keeping, the sight-bar range, and by diminishing the present unavoidable errors of the gun.

8. With all of the unavoidable errors just mentioned, it is possible to make, with a certain gun, at a certain range, only a certain maximum percentage of hits on a target of a given size.

9. If we actually make this maximum possible percentage of hits, say 20 per cent, at a certain long range, it shows (*a*) that our pointers have faithfully applied their skill by aiming accurately, as directed, and (*b*) that the range party has established the correct range. If we make less than 20 per cent, either the aiming or the range-finding has been inaccurate—we cannot tell

which, but the chances are very large that the range-finding is at fault.

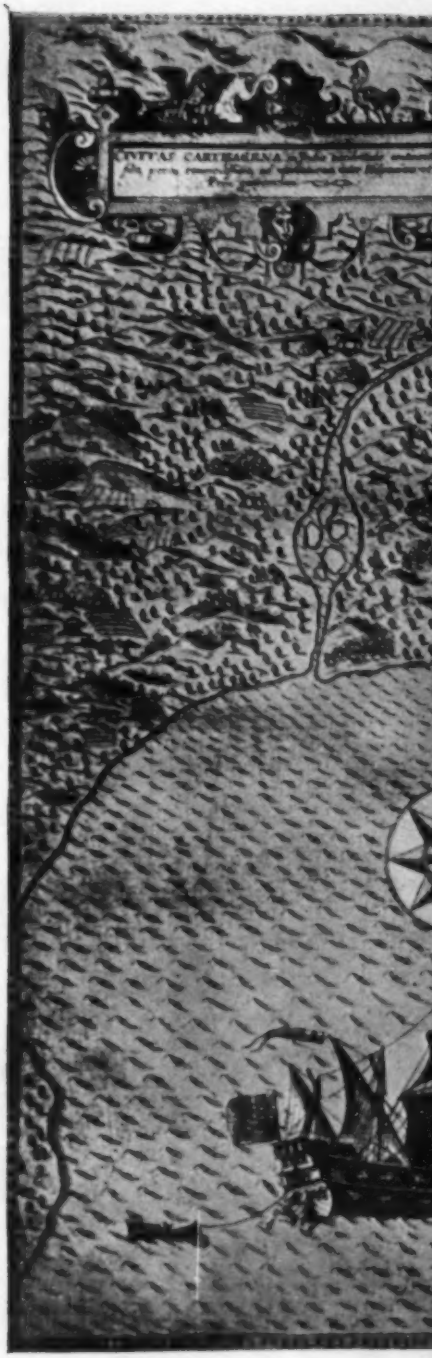
10. With reliable pointers at the guns, long-range firing becomes, therefore, principally a training in range-finding—whatever the method employed.

11. With unreliable pointers at the guns, long-range firing is an inexcusable waste of ammunition, because, when you do not make the percentage of hits that you should (say, 20% in this case), it is impossible to tell where the fault is, therefore the firing is not training for anybody concerned.

12. In order to train new pointers, and maintain and test the skill of old ones, we must always fire at training ranges; and this practice can never be abandoned without an immediate loss of *accuracy in aiming*, which is the *first essential* to the success of gun-fire at sea; for if the pointers are not both *skillful and reliable*, all firing at battle ranges is practically useless as a training of the "ship" in the *second essential* requirement—accurate range-finding. For upon accuracy of pointing and accuracy of range-finding depend the success that it is possible to achieve with the guns you are given to shoot with.

You must first train your pointers always to aim accurately, then train your "ship" to get the maximum results from their skill. At long ranges, even perfect pointers would be useless on an untrained "ship," and *vice versa*.

The foregoing explanations refer only to the vertical errors due to errors of pointing, errors of the gun and errors of range-finding; but, while these are not so easy to avoid as lateral errors, still the latter present many difficulties. The most serious of these can be compensated for only by fitting the guns with properly designed sighting appliances. It follows, therefore, that long-range firing, underway, carried out with guns not so fitted, is profitable only to the manufacturers of ammunition.



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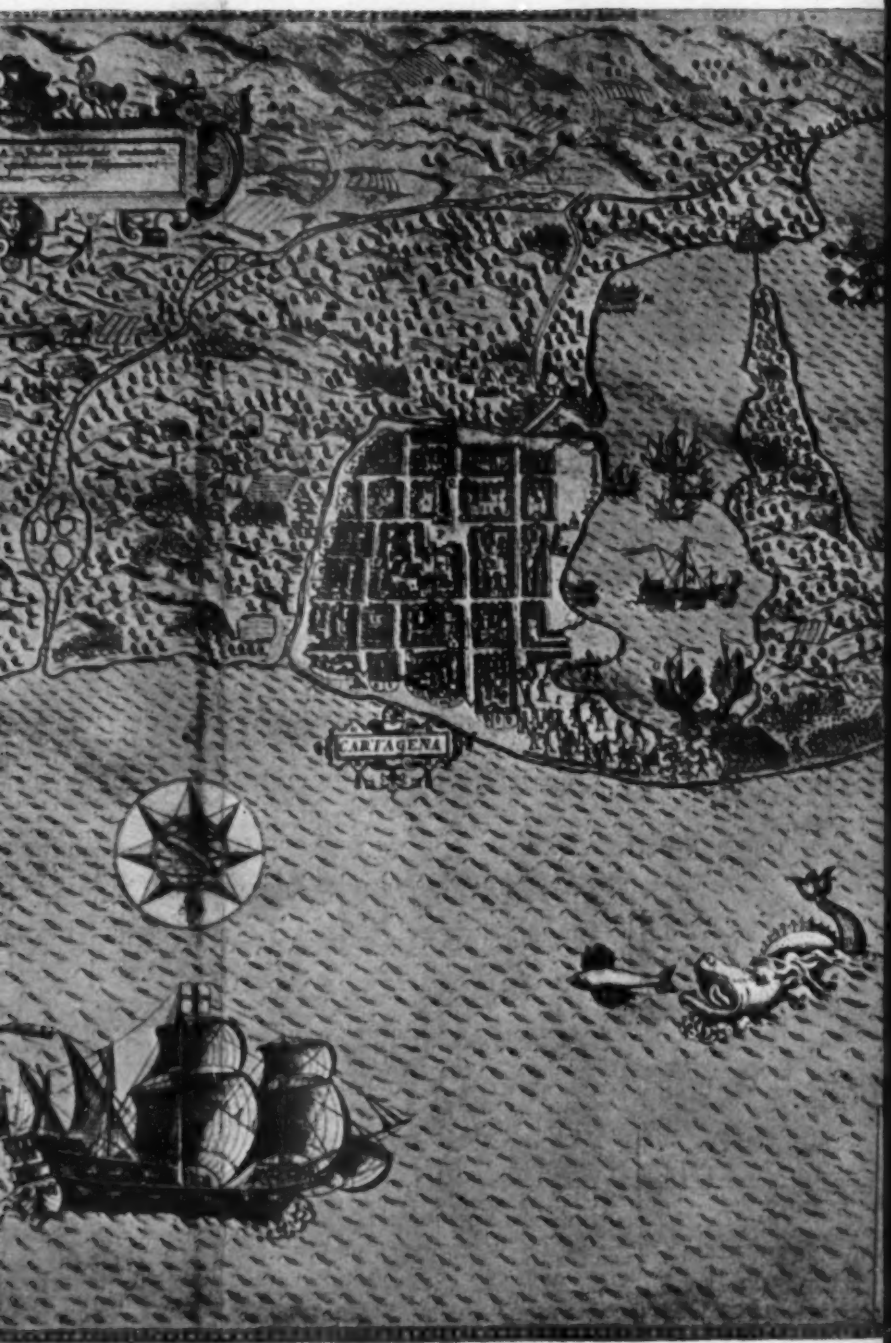
A. The place where the whole fleet anchored.
B. The place where the pinnaces and ship-boats did set the soldiers ashore.
C. The way in which our army marched along the sea side.
D. Small sticks in great numbers of half a yard long ... all dressed with a most villainous and mortal poison.
E. The troop of pikes and shot which had the vanguard of our army.
F. A fortification built of stone-work clean



CONTEMPORARY MAP ILLUSTRATING DRAKE'S ATTACK ON

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G. Two great galleys, to flank us in our approach, in which galleys were planted eleven pieces of ordnance and 400 soldiers . . . all small shot.

H. A great galleasse well furnished with ordnance which she employed as she might but not to any purpose.

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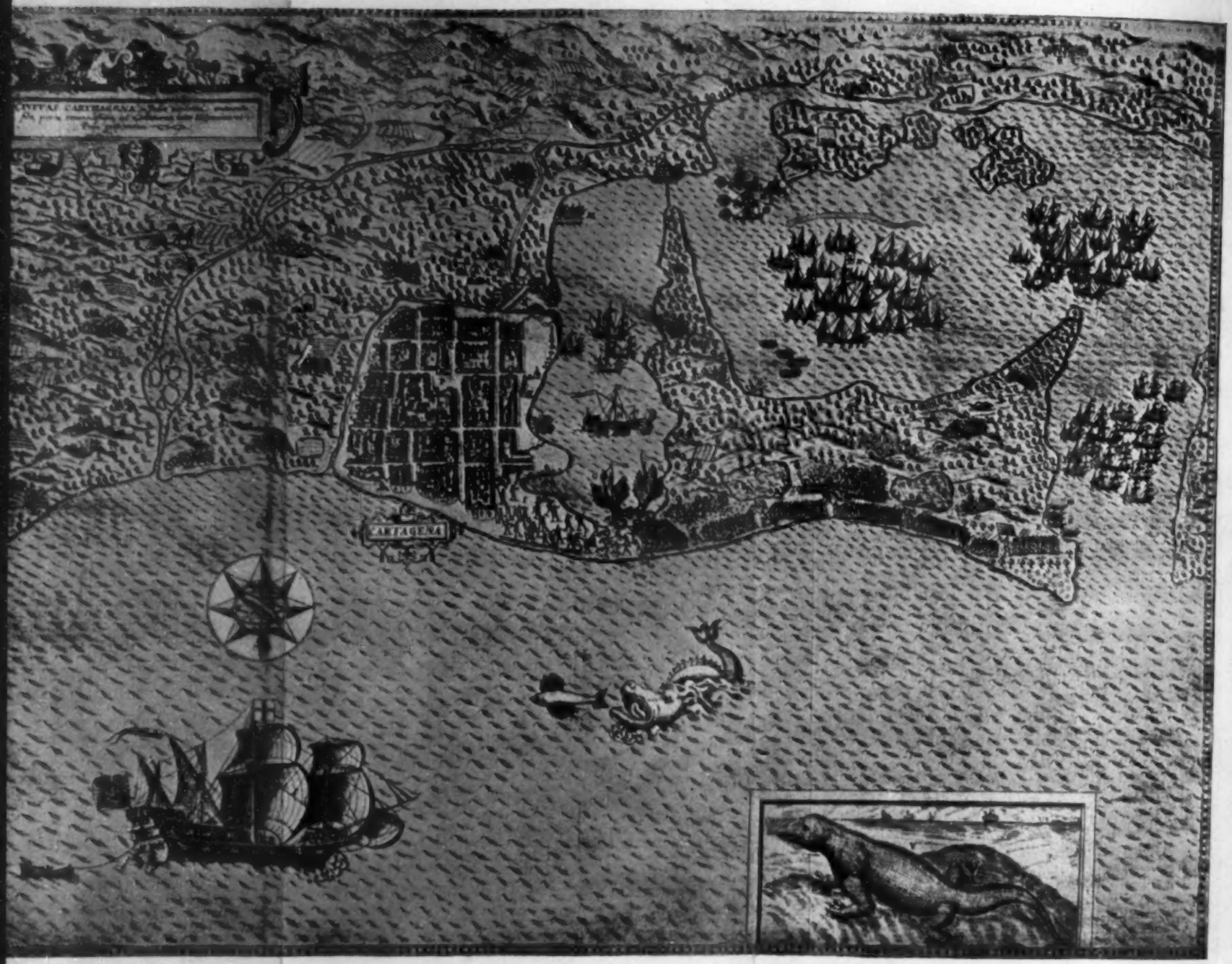

CONTEMPORARY MAP ILLUSTRATING DRAKE'S ATTACK ON CARTAGENA IN 1586.

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G. Two great galleys, to flank us in our approach, in which galleys were planted eleven pieces of ordnance and 400 soldiers . . . all small shot.

H. A great galleasse well furnished with ordnance which she employed as she might but not to any purpose.

I. The Spaniards flying away after our entry.

K. Certain pinnaces of ours which entertained a little skirmish with the fort of the haven.

L. The fort which kept the inner haven.

M. The place where the two galleys were burned.

N. The place where our fleet anchored the second time, which was after the town was won.

O. Ships of theirs we burned.

P. The market place.

Q. The church, which was newly built of very fair stone-work, which was by us much ruined again by a chance in shooting a piece.

R. A bridge by which the Spaniards took their flight.

S. The place where our ships anchored the third time being upon our departure.

T. An island wherein is planted as in an orchard a great number of delicate fruits.

V. A beast called a Guana . . . a very delicate meat (long description follows).

X. Two lakes of standing water, being brackish.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

A STUDY OF ATTACKS UPON FORTIFIED HARBORS.

By Lieut.-Comdr. W. L. Rodgers, U. S. N.

In making the following study of certain attacks upon fortified harbors it was my object to make an analysis of each campaign, and of them all collectively, in order to attempt to derive well grounded conclusions as to future wars.

It is a fact inspiring confidence in tactical conclusions resulting from historical study, that although the deductions presented in this paper were completed before the outbreak of the present war in the East, nevertheless the operations there have not at all shaken them.

By studying the history of a number of attacks upon fortified harbors at various periods in the past we may see the direction that progress is taking, and precisely as artillerymen observe the course of a ship and then, predicting her position at a given instant, aim and fire a gun with reasonable accuracy; so, by an observation of the battles of the past we may expect before a war, to predict within limits the tactical methods which will be adopted to the ships, guns and defences to be employed. At least, if we cannot go very far in this way, there seems no other way in which we can further.

It may be well to say in the beginning that, after studying the operations described and making an abstract of the various accounts of each, a slow progressive change in the tactics of the past seemed sufficiently apparent to indicate grounds for making a correct forecast as to future tactics.

From both the successful and unsuccessful attacks which we shall review it will be apparent that fortified harbors are properly

attacked only by joint operations of the army and navy, and we shall see several examples both of the points which must be observed and those which must be avoided in order to secure success.

I shall begin by drawing attention to former operations about Cartagena, United States of Colombia. This place is selected for two reasons. 1. There has been a series of attacks on the place of which the first was over three hundred years ago and we may trace the development of tactics on both sides upon the ground with much profit. Secondly, it is of interest because the imperfect government of the country and the strategic situation of the harbor with relation to the Panama canal combine to render it a position which any great power operating in the Caribbean may find it desirable to hold in alliance with Colombia. It is therefore entirely within the range of possibilty that the locality may become one of naval importance, as it has been in the past.

As is seen from the map, the city occupies a low level site directly on the ocean, where the surf breaks heavily on the sea front of the fortifications. To the north and east the beach stretches for miles with a shallow lagoon a few yards behind it, and to the south and west is the magnificent harbor with from 8 to 12 fathoms of water, 10 miles long by 3 to 5 miles wide. The harbor is protected by the island of Tierra Bomba which forms a breakwater with an entrance around each end. The northern entrance, Boca Grande, is wide but has shoaled by nature and by artificial means so that for centuries the main entrance has been at the southern end of Tierra Bomba by Boca Chica, which is narrow, crooked and easily defended.

On the land side the isthmus between the lagoon and the harbor forms the main approach to the city and is controlled by the fort of St. Lazar and the lofty hill of La Popa crowned by a heavily built nunnery. It may be perceived at once how many reasons, military and others, led the besiegers in the past to consider an early and successful surprise of La Popa as most desirable.

The city of Cartagena was founded in 1532 upon a fine harbor site and speedily acquired great importance from its commanding situation with regard to the commerce of the Caribbean. It is near the Magdalena river, which is the great line of trade to the interior of Colombia, and a canal was cut from a point near Cartagena to the river, so that Cartagena became the seaport for the river trade.

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CARTAGENA AND BAY AT PRESENT (1904).

Further, the position of Cartagena with reference to the trade winds and the geography of the Caribbean was such that the west coast trade crossing the isthmus at Panama, together with the Atrato river trade, had to work up under the lee of the land as far as Cartagena before it could venture to head off shore to make for the Florida straits. Similarly the trade to Europe from east of Cartagena touched there because it was the last point on the coast at which the trade winds permitted a call before starting for Havana.

Thus all the commerce of Spain with the north and west coasts of South America and the west coast of Mexico was centered at Cartagena, and its wealth became enormous.

The first attack on Cartagena to be examined was that by Sir Francis Drake in 1586. Drake had been urging Queen Elizabeth to attack the Spanish Dominion over seas for several years, but without success until 1585, when captured despatches revealed to her beyond a doubt the King of Spain's intention of attacking England. Thereupon she directed Drake to set out, and he did so in September, 1585. His plan of campaign, as shown in papers by himself and his companions, was as sound as if he had studied strategy from a book. He proposed by attacking the principal centres of Spanish commerce in the West Indies to capture their treasure fleets, as he had done before, and to divert from Spain to England the stream of tribute upon which Spain relied to prosecute her intended attack.

The expedition as organized on leaving England in September 1585 consisted of 29 ships and pinnaces, the largest of 600 tons and the smallest of 40 tons, 1300 mariners and ten companies of soldiers; the whole force of about 2300 men being commanded by Admiral and General Sir Francis Drake, with Martin Frobisher as Vice-Admiral, and Christopher Carleill as Lieut. General, commanding the soldiers. After capturing Santiago in the Cape de Verdes and San Domingo in Hispaniola, and putting them to ransom, the expedition sailed for Cartagena where it arrived February 11, 1586. The town had received notice of his impending arrival both from Seville and from San Domingo, and made preparations, although the vast fortifications now there were not built until later.

Drake himself was his own pilot, since he failed in capturing any local fishermen, and he had to rely on his experience there in his

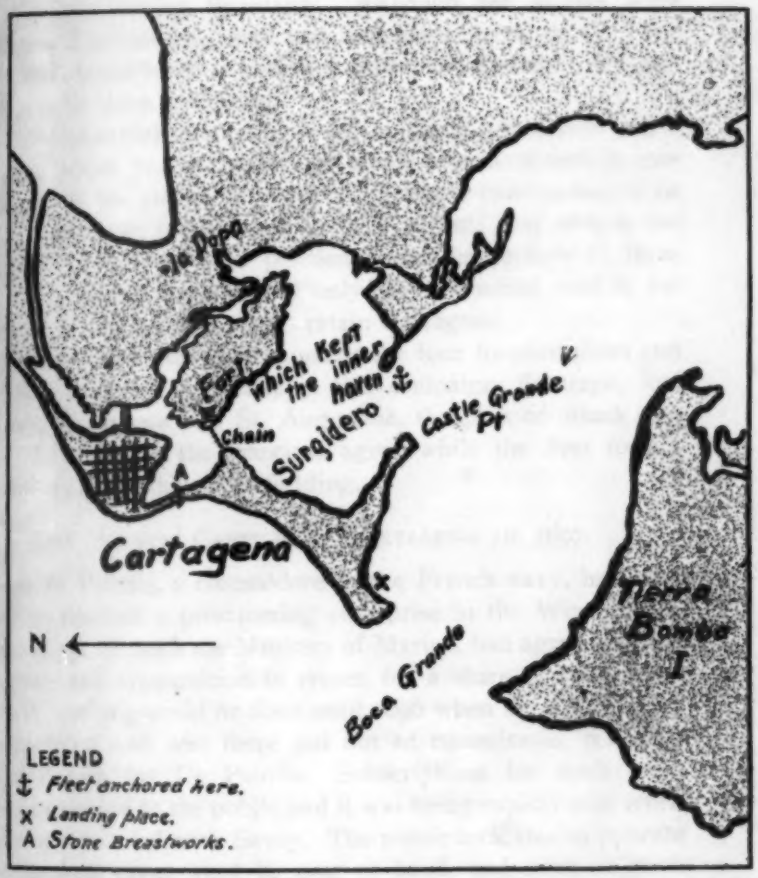
freebooting days when he took shelter in the harbor from a gale and defied the efforts of the city to drive him out.

The Spaniards had collected a force of 50 lancers, 450 harquebussiers, 100 pikemen, 20 negro musketeers and 400 indian bowmen, over one thousand in all. There were also two galleys in port as guardships, manned by 150 harquebussiers.

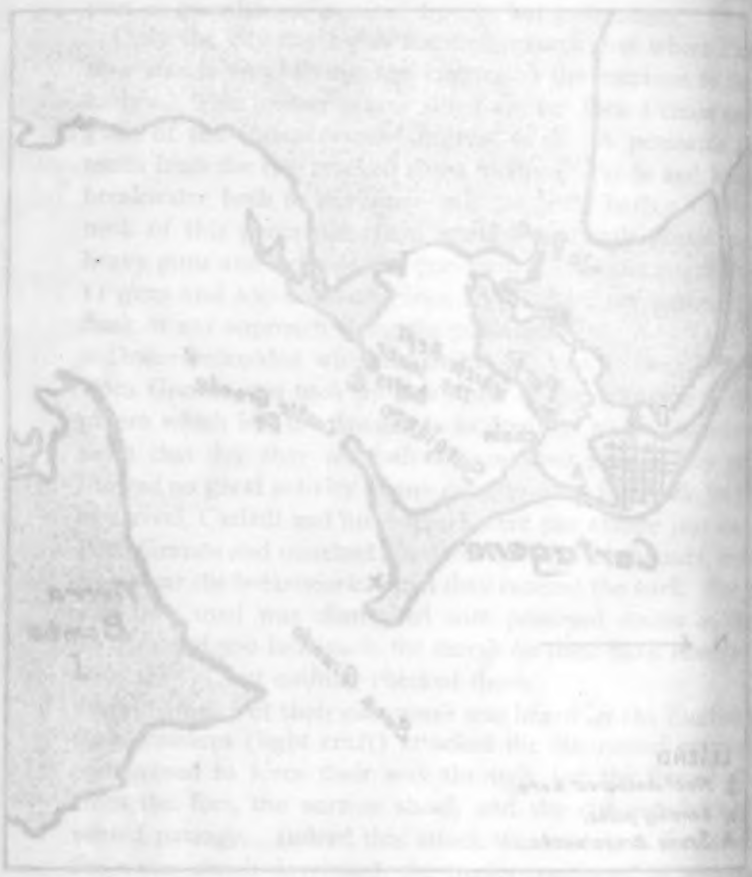
Only the city itself was fortified, except that where Pastellillo now stands an outlying fort controlled the entrance to the inner harbor. This harbor is now silted up, but then a chain under the guns of the fort prevented ingress to it. A peninsula running south from the city reached down to Boca Grande and formed the breakwater both to the inner and the outer harbor. Across the neck of this peninsula ran a stone breastwork armed with five heavy guns and defended by 300 men. The port guard ship with 11 guns and 400 small-arm men lay in the inner harbor upon the flank of any approach along the peninsula.

Drake proceeded with despatch. He ran at once through the Boca Grande and took up a position in the entrance to the Surgidero which left the Spaniards in doubt as to his intentions, and as at that day they were already *mañana* people they probably showed no great activity in any direction. After dark, on the day of arrival, Carleill and his soldiers were put ashore just inside the Boca Grande and marched along on the edge of the surf, until they were near the breastwork, when they entered the surf. The causeway they used was obstructed with poisoned stakes as chevaux de frise and 500 Indians in the marsh on their flank annoyed them with arrows, but nothing checked them.

As the noise of their encounter was heard by the English ships, their pinnaces (light craft) attacked the obstructed entrance and endeavored to force their way through, but the fire of 16 guns from the fort, the narrow shoal, and the chained fairway prevented passage. Indeed this attack was merely a diversion. As the water attack developed, the troops continued to advance and coming under the flanking fire of the galleys they bore off into the surf where they were sheltered by the swell of the land. On reaching the stone breast work with its heavy guns, about dawn, it was found not to reach all the way to the sea, yet the gap was closed by a flimsy improvisation of barrels filled with earth. These were quickly torn down and for a few minutes there was a furious hand to hand encounter in which, like Homer's heroes, the leaders



SKETCH ILLUSTRATING DRAKE'S OPERATIONS AGAINST CARTAGENA IN 1586.



sought each other and crossed weapons. The Englishmen had longer pikes and they wore steel armor, while the Spaniards had adopted cotton quilted jackets on account of the climate, and soon the Spanish leaders were killed and the English entered the city gate with the fleeing Spaniards. Although the streets were trenched and barricaded, there was little further resistance. The galleys were burnt by their escaping crews, and Drake in full possession put the town to ransom.

He had apparently hoped to hold the place permanently as a base from which to disorganize the whole commerce and finance of Spain, but the yellow fever came on board months before he sighted Cartagena, indeed, before he was half way across the ocean, and now, what with pestilence and the capture of three great cities, Drake could muster only seven hundred men fit for duty. So it was decided not to retain Cartagena.

It may be added that at each one of the four fortified cities and roadsteads captured by Drake in this campaign, Santiago, San Domingo, Cartagena and St. Augustine, the plan of attack employed the army as the principal agent while the fleet took a very minor part in the actual fighting.

The French Capture of Cartagena in 1697.

Baron de Pointis, a commodore in the French navy, had long wished to conduct a privateering enterprise in the West Indies, and the King, through the Ministry of Marine, had agreed to lend ships, men and ammunition in return for a share of the profits. However, nothing could be done until 1696 when the Toulon fleet came to Brest and was there put out of commission, releasing ships and men for De Pointis. Subscriptions for stock were thereupon opened to the public and it was being rapidly sold when peace was concluded with Savoy. The public took this to indicate that a general peace must be near at hand, and sales of stock ceased. Thus the size of the expedition had to be curtailed to suit the funds in hand, and in October, 1696, the fitting out of the squadron began.

On January 6, 1697, the expedition was ready except for a large convoy of arms and provisions shipped at Rochelle, but whose arrival was prevented by the difficulties of the blockade. Just as De Pointis was resolving to sail and pick up his stores in order to get off before peace should balk him and waste his investment,

the flotilla arrived, and the following day, eluding the blockade, he was off.

At the time the expedition was resolved upon, in September 1696, a letter was sent to Du Casse, Governor of Hayti, informing him that De Pointis was going out with 7 ships, a galliot and 2 flûtes with 2000 men as a landing force to capture some coast town, and that the King desired all the resources of the colony should be employed to aid the expedition and that it was hoped not less than 1000 or 1200 men would be ready to accompany De Pointis immediately upon his arrival.

It will be well to sketch here the characters of De Pointis and Du Casse, who took a great share in the campaign.

De Pointis had courage, experience and professional skill. He was capable of forming a great plan and adhering to it, but he was vain, with an idea of his own merits so great as to prevent his perceiving those of others. He had so great a private stake in this expedition that its advancement became a dominant passion, improperly influencing his public conduct.

Du Casse never forgot that his first duty was towards the state and put public matters before his own affairs. He was always ready to acknowledge the good work of others. No misfortune ever found him without resources. His failures gave him reputation as well as his successes.

In January, 1697, Du Casse was ordered to assemble and maintain all the filibusters of the colony until February 15 when De Pointis was expected. It was a difficult task that was set him as the filibusters were restive under enforced idleness and De Pointis did not arrive on time. Much diplomacy was shown by Du Casse in holding the filibusters together.

De Pointis arrived at Cape Haitien on March 1 and found that certain regular forces he relied on had gone back to France. On March 16 De Pointis and Du Casse met for the first time and began their quarrels, which lasted through the expedition. De Pointis was angry that only 1200 filibusters and colonists had been assembled and accused the governor of seeking to delay the expedition, declining to accept the explanation that the colony could not be stripped of men. Thus the expedition was only about half as strong as had been planned before leaving France.

Du Casse as the Governor of the Colony felt obliged to protect the interests of his filibusters, and there was much haggling over

the terms for sharing the booty. De Pointis soon offended the filibusters and Du Casse thought that only by going in command of them himself could he assure their good service. He wrote to the Ministry that as his orders did not forbid him to leave the colony he felt obliged to go, however distasteful to himself, as otherwise the colonial forces would be unmanageable by De Pointis and the best defense of the colony would be by making the expedition as great a success as possible. In fact, De Pointis soon perceived that Du Casse's services were essential; for when a riot occurred among the filibusters which De Pointis could not quiet, it yielded immediately to Du Casse. Nevertheless, although Du Casse was the Governor of the Colony and the senior naval officer excepting De Pointis, and joined a great reputation to exceptional experience in the West Indies, yet De Pointis refused him any adequate command in the fleet and he went as a volunteer in charge of the colonial forces.

The expedition finally anchored off Cape Tiburon to select a point of attack. Du Casse preferred Porto Bello, as the Spanish treasure ships were likely to be there or on their way to Cartagena, but De Pointis preferred Cartagena for reasons connected with the trade winds and the amount of provisions on board.

At last they sailed, and anchored 15 leagues to windward of Cartagena on April 6, 1697. Contrary winds detained them here a week and the time was spent in perfecting the organization.

In the home squadron there were seven large ships carrying 464 guns and 2950 men besides frigates carrying 136 guns and 800 men and a couple of light craft. The filibuster squadron commanded by Du Casse included 8 ships of moderate size, besides some smaller ones. Du Casse provided 170 soldiers from the garrison of Hayti, 110 colonists, 180 negroes and about 650 filibusters. Thus there were in all about 4000 men, including 110 officers, 2100 seamen, 1950 soldiers and 55 marine infantry. The troops were organized in 6 battalions and a battalion of 400 blue jackets made a seventh. This was a great reduction upon the original plans which provided 5000 men for landing. De Pointis had originally contemplated landing on the open beach to windward and getting in rear of the city, but with his reduced force this was impossible without stripping the ships of seamen, which could not be thought of in view of the weather at this season, and of the information that the English fleet was aware of their presence in the Caribbean.

At this time the Boca Grande was completely closed by a great earthquake and De Pointis next thought was to force the Boca Chica and afterwards capture the fort there. Then, by bringing the fleet inside, he could hold the entrance fort and so put his ships in security against wind and enemy, thereby releasing a large reenforcement of seamen for the land attack on the city.

This plan was rejected because the narrow, winding channel required warping to enter, and two ships opposing the entrance in addition to the fort could effectually prevent forcible entrance.

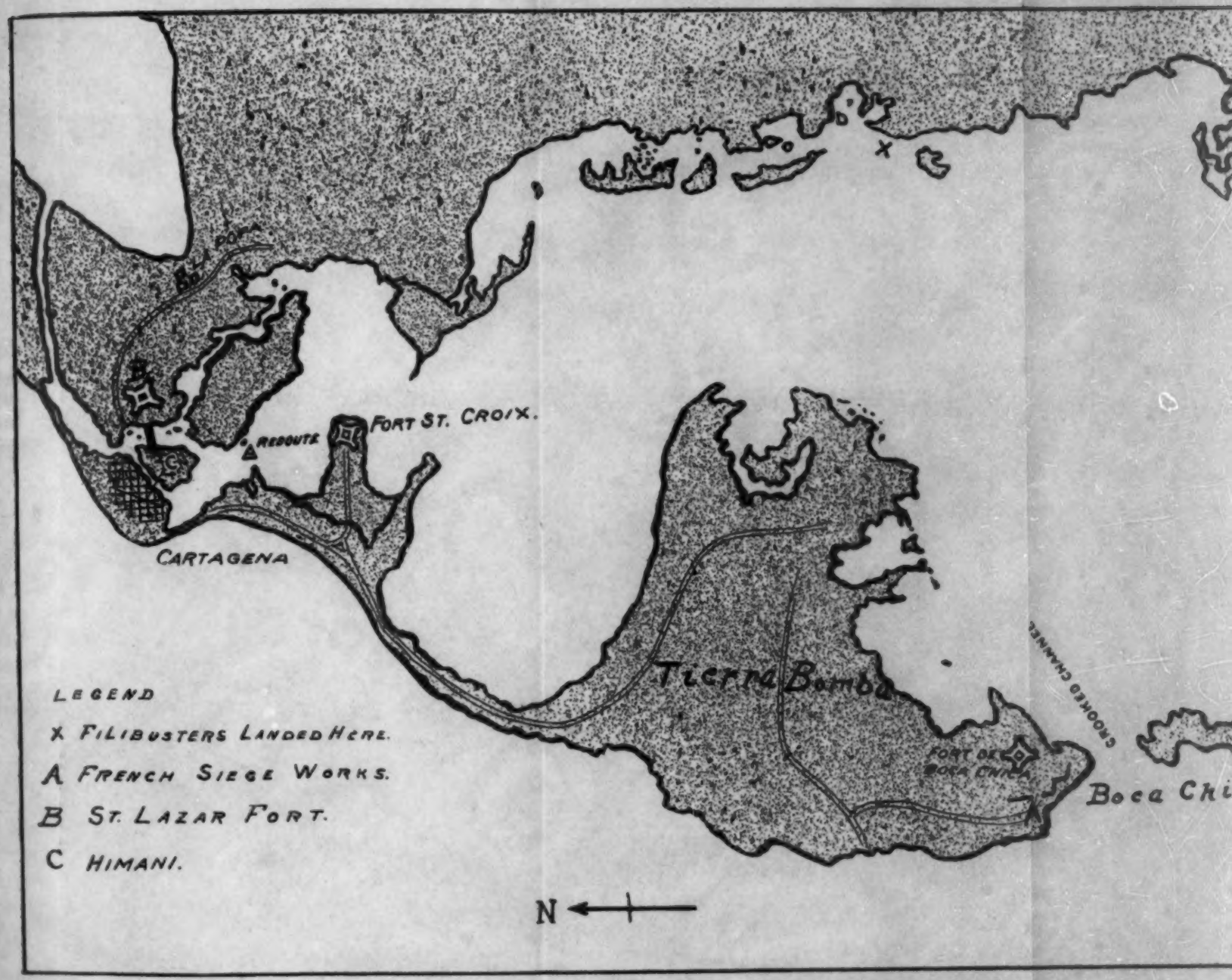
It therefore seemed best to land on Tierra Bomba from the sea and by promptly landing the siege batteries with which the fleet was well equipped, and establishing them on the harbor side, any hostile ships would be driven back while the mortar fire would bring the fort at Boca Chica to terms.

After entering the harbor in this way, in case the galleons should not be found, after securing the ships it might be possible to capture Cartagena by landing the seamen to reenforce the troops.

The notes, information and instructions furnished to De Pointis from the Ministry covered several localities. In regard to Cartagena they were much in error, and De Pointis refused to listen to Du Casse who had the best information from spies. Nevertheless the Paris notes were right in describing the convent and hill of La Popa as commanding all the land approaches to the city. By his instructions from Paris, De Pointis was required to seize this hill as his first operation and he determined to commit the enterprise to Du Casse and his buccaneers before attempting to enter the harbor. They were to land N. E. of the city.

The fleet arrived off Cartagena on April 13 and that very night the filibusters expected to land. While preparations were being made, De Pointis, Du Casse and others embarked in a small boat to reconnoitre the beach and were nearly drowned in the surf. The landing was countermanded.

On the 14th the fleet weighed anchor, intending to bombard the city in passing, but it was found that the knowledge of the locality was so imperfect that the day was spent in surveying. A distant cannonade of the city developed the presence of many heavy guns. Late on the 14th the fleet anchored near Boca Chica and sent a detachment to blockade it. On the 15th reconnaissance was made to select a landing and at noon Du Casse landed with 80



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negroes, and, finding no ambush, De Pointis landed 1000 men, grenadiers, filibusters and negroes. The negro pioneers cut a path across to the lake side about half cannon shot from the fort on which pickets were placed at each path leading to the city. The troops occupied a strong position hidden in the woods about two gun shots (800 yards) from the Boca Chica fort. During the landing the distant fire of the ships of the line and mortar boats occupied the enemy's attention. The fort's return fire was slow and did little harm. At dark several of the principal officers passed around the fort and observed it closely. During the night and on the morning of the 16th siege material was landed and trenches opened on the sea side of the fort where the wood approached it most nearly.

On the 16th De Pointis sent to demand the surrender of the fort by the mouth of a monk he had just captured in a small boat. This was refused, whereupon the mortars opened fire both ashore and afloat. This day two pirogues containing a reenforcement of 300 men were sent down from the city. On arriving near the fort, the filibusters in ambush along the lake shore left their shelter and ran to the shore to fire on the boats, but thus exposed themselves to the fire of the fort as they ran along the beach. The Spanish boats went back while Du Casse endeavored to get his men under shelter. Some retreated, but others instead rushed to the fort and established themselves at the foot of the counterscarp, which was so badly designed as to give protection against the fire from the rampart. De Pointis came to remonstrate with Du Casse, but was induced to support the filibusters with regular troops. The fire of the fort was silenced. Scaling ladders were brought up and assailing columns formed and then a parley flag was shown by the fort. Good terms were allowed and the governor handed the keys to De Pointis with the remark: "I deliver you the keys of all the Spanish Indies." The French lost 50 men, while the garrison of 300 lost 90 men. Thus the entrance was open after two days' work.

The fort was garrisoned by the French in order to protect their shipping during the attack on the city.

On the following day, the 17th, the siege material was re-embarked and the fleet moved close to the entrance, but in spite of De Pointis' anxiety to surround the town before its riches could be sent inland he was afraid to lose touch with the troops on shore

and did not permit the regulars who had been landed to abandon their position at Boca Chica until all the shipping was inside. Buccaneers, over 600 in number, however, were pushed across the lake on this date, apparently in local craft, with orders to seize La Popa and cut off the city. After a march of 4 leagues, through the forest, where two ambushes were encountered, La Popa was reached and found abandoned. The filibusters advanced close to St. Lazar on the morning of the 18th and halted there without attacking, to wait the arrival of the regulars.

On seeing the filibusters across the lake the Spaniards burnt three galleons and a pirogue which sunk so as to close the entrance to the harbor at Fort Santa Cruz.

On the morning of the 18th the fleet began to warp in and De Pointis, now sure that he would not be cut off from his ships, started his soldiers to march on the city. He had with him 1700 soldiers, 180 negroes and a few seamen and 110 Haytien colonists. Fort Sainte Croix (or Santa Cruz) was bombarded by the shipping in the morning and when the troops from Boca Chica arrived about noon it was found abandoned with its guns removed, as the Spanish Governor feared to have the garrison cut off from the town.

De Pointis then reconnoitered the approach to the city by way of which Drake had gone, but found the tremendous bastion of San Domingo opposed to him forbidding assault, and although he summoned the governor to surrender, he recognized that the ground was too near the sea level to carry out regular siege operations. Early on the morning of the 19th the troops were ferried across the lake, the negroes reconnoitering and De Pointis joined the filibusters under St. Lazar in time to reconnoiter that post before dark, and to discover that it was so strong as to stop all attempt upon the city until after it should be captured.

In the morning of the 20th a further examination showed that St. Lazar was commanded by the spur sloping down from La Popa and that troops could advance in the wood along this spur close to the fort and then mine it. The negro pioneers were thereupon called to cut a path which, in the neighborhood of the fort, was forked to lead on both sides of it. The troops followed and opened fire while the scaling ladders were sent for; the garrison made no effective return fire, and soon abandoned the fort, fearing to be cut off.

The French then advanced to the bridge and causeway leading to the suburb of Himani where they were sheltered from view by the Hospital of St. Lazar whose high walls with some trees gave concealment. The ships got up this day and opened fire with a mortar boat and galliot, but they were obliged to withdraw.

Everyone was put at work, the soldiers made fascines and gabions, the seamen landed the artillery and the negroes dragged the pieces, while the filibusters reconnoitered and ravaged the country and secured intelligence.

As the ships employed in the bombardment needed full crews there were not many sailors available for disembarking stores, but in six days there were landed and moved half a league into position, 27 guns, six of which were the largest cannon of the day 36 pdrs. and 24 pdrs. and 5 mortars, besides all their supplies. Of these guns 5 were at the foot of St. Lazar, 7 in that fort and 9 on the hill to the right of the fort. The 6 heavy guns were only 120 yards from the gate. On the 28th the siege batteries began to play on the wall, while the ship "Vermandois" and the mortar boat had begun fire even earlier. Upon the 29th three large ships added their fire to that of the siege batteries but could not reach the same bastion as that on which the latter were working.

On the 30th a curious incident brought a great success to the French. A negro, native to Cartagena but coming from Hayti with the French forces, thought proper to advance to the breach with a flag of truce. Fire ceased and the negro was asked his errand. He said he wanted news of his relatives and of the town, and also took the opportunity to advise the town to surrender. Du Casse ran up to see what was happening and met the Spanish senior officer similarly attracted and after conversation the Spaniard asked for an armistice of two hours to confer with the Governor. This was declined by Du Casse, who had seized the chance of examining the breach and thought it practicable. He sent word to De Pointis advising immediate assault and at 4 p. m. the regulars advanced followed by the filibusters. But the regulars moved circuitously to avoid obstacles while the filibusters pushed straight on and arrived first at the beach. Du Casse planted the French flag on the rampart. The Spanish resisted at first, but soon the regulars got forward to support the filibusters and drove the Spaniards through the suburb upon the causeway leading into Cartagena. The Governor refused, however, to open the gate

until the fugitives should have attacked the French, so, urged, as De Pointis says, by necessity and the liquor they had drank, they made a little counter attack, which drove back the French who, however, soon rallied and killed all they could without quarter, but this time the Governor admitted the fugitives through a little postern gate.

On May 1st, the siege batteries were moved into position on the ramparts of Himani, after the bridge had been repaired that it might bear the siege guns, and on the 2nd the fleet opened fire. After three hours' bombardment the governor asked for terms, which De Pointis refused. At this instant news was brought of the approach of two relieving forces of 1000 or 1200 men each from the interior who proposed to get into Cartagena by the Sta. Catalina bastion. Du Casse went out to oppose them with his filibusters, but it turned out that hearing Himani had fallen they did not advance. Still, the news made De Pointis more ready to treat, and on the 3rd a capitulation was signed by which the garrison marched out with the honors of war, while all public treasure and private personal property was to be surrendered as prize.

The Spaniards never once made a sally.

The English Attack on Cartagena in 1741.

Vice-Admiral Edward Vernon was the British Commander-in-Chief in the West Indies in 1740-41. In the fall of 1740 he learned that a large expedition was to be sent to the West Indies from England and the North American colonies, but unnecessary delays in starting caused it to arrive later than was desirable in view of the season of the year. Vernon sailed from Jamaica to meet it in October, 1740, but instead he met only the colonial troops and the news that a Spanish squadron had arrived at Cartagena and a French one at Hayti, each superior to him. France was not known to be at war with England, but there was every reason to fear the instructions which the French squadron brought with it, so Vernon retired to Jamaica.

Rear Admiral Sir Chaloner Ogle with a powerful fleet of battleships conveying the transport fleet with the troops under the command of General Lord Cathcart arrived at Dominica on the 19th of December, 1740, where Lord Cathcart died. He was considered a man of great ability and one with whom Admiral Vernon would cordially cooperate. His successor, General

Wentworth, was a man of much less ability and far from enterprising, although apparently well disposed. On the other hand, Vernon was a man of ability with a great reputation, yet hot-tempered, overbearing and contemptuous towards his associates. His friends in England had thought wise to warn him against these failings.

On January 7, 1741, Sir Chaloner's fleet arrived at Jamaica. This arrival changed the situation at Jamaica so as to open possibilities of offensive operations.

The orders of the ministry sent out with the troops placed the control of the campaign entirely in the hands of a council to consist of the two senior officers of the Army and Navy to whom should be joined the Governor of Jamaica when his presence could be obtained. It was necessary first to gain some intelligence of the movements of the French and Spanish fleets. Accordingly a scout vessel was sent to windward to examine Hayti and the whole fleet followed, transports and all. On arrival off Port Louis on February 12th it was found the French fleet was absent. As war was not yet declared the fleet watered there and learnt the French fleet had sailed for home, so that all was clear for operations against the Spaniards. Another council was called to select an objective for the campaign. Public opinion at home wished to seize Havana and conquer Cuba, but the council decided for an attempt on Cartagena, and on February 25th it sailed for that place. The force counted 124 sail in all, of which the combatant ships were 29 battleships, 12 frigates, 7 fire ships and 2 bomb ketches, manned by 15,400 blue-jackets. The transport fleet carried 12,000 troops, including 2 regiments of foot troops, and 6 regiments of marines amounting to 8000 men, artillery and detachments 1000, the American regiment 2500 and 500 negroes.

The garrison of Cartagena consisted of 4000 men, besides which there was a squadron present of 6 heavy ships, besides galleons and small craft. On March 4th the entire fleet anchored to windward of Cartagena and the small craft were sent inshore to draw the Spaniards towards them by feinting at landing.

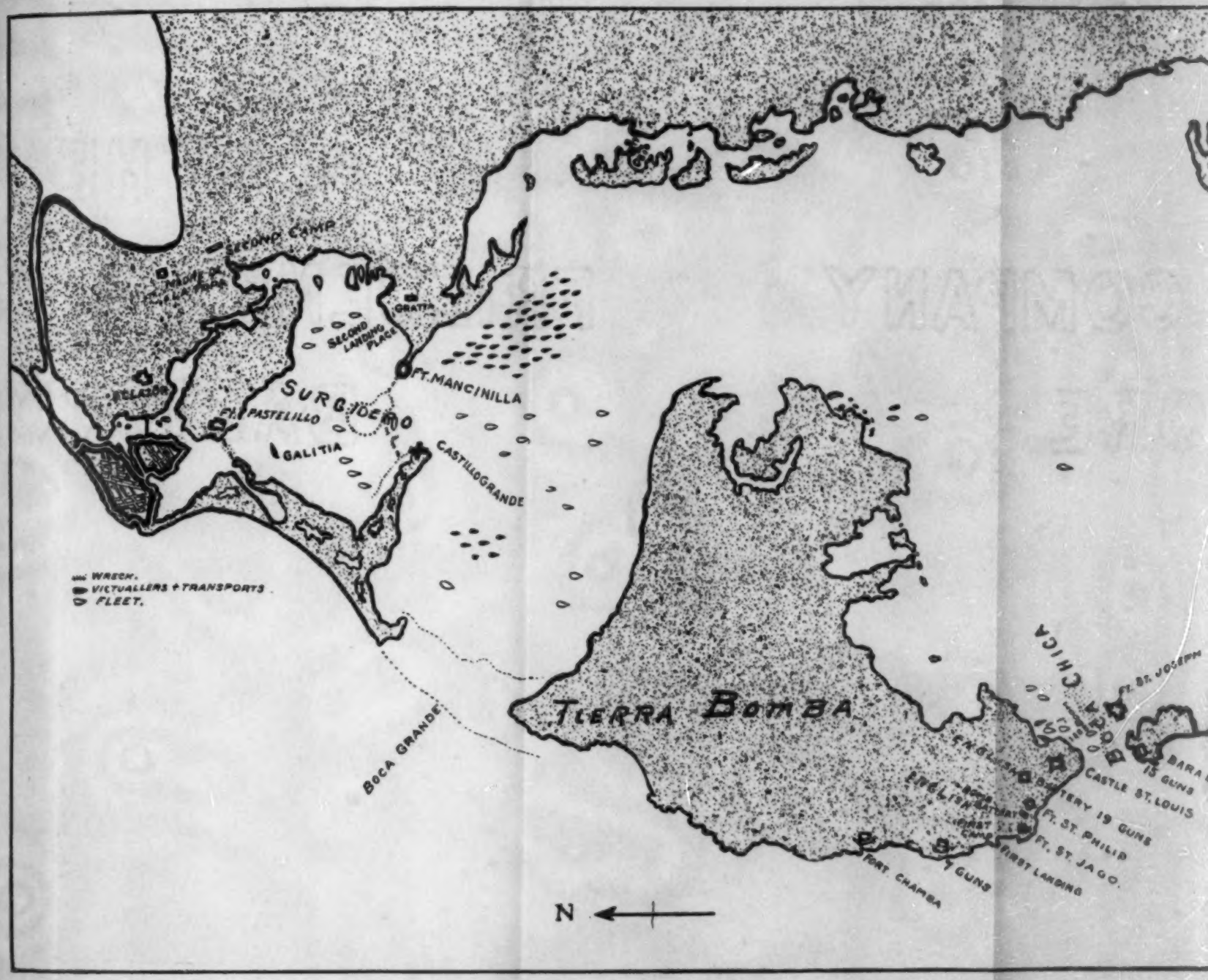
This feint was successful, and during it a number of ships were sent to sound along the coast and reconnoitre the shore. From their report it was arranged that Sir C. Ogle with his division should drop down to the harbor mouth.

The following is a contemporary description of the place and its

defenses at this time, there having been changes since the French attack:

"The town is directly on the sea, but the water begins to shoal a league off and the surf and rocks prevent landing. The only entrance into the harbor is more than two leagues from the city between two narrow peninsulas. This, called Boca Chica, was defended on the Tierra Bomba side by a castle called St. Louis, which was a regular square with four bastions, strong, well built, mounted with 82 guns and three mortars and was capable of making a stout defense if well garrisoned, and would have been much stronger if the glacis and counterscarp had been finished. To this were added the forts of St. Philip, mounted with 7 guns, Fort San Jago, mounting 15 guns, and a small fort of four guns called Battery de Chamba, which served as outworks to Fort St. Louis towards the sea.

"On the other side of the mouth of the harbor was a fascine battery of 15 guns called the Baradera, and in a small bay at the back of that another battery of 4 guns, and facing the entrance of the harbor on a small flat island stood Fort St. Joseph of 21 guns; from this fort to Boca Chica Castle a boom and cables were fixed across, fastened with three large anchors at each end and just within the boom four men-of-war were moored in a line, the "Galicia," on board which was the Spanish admiral, and three others of 70 and 66 guns each. These spread so far across the mouth of the harbor that there was not room for a ship to pass ahead or astern of them so that it was impossible for shipping to force an entrance to the harbor. Beyond this passage lies the great lake or harbor of Cartagena. Within a league of the city two points of land jutting out form the lesser harbor. On the northernmost of these is the strong fortress of Castillo Grande, about 8 miles up the harbor, being a regular square with 4 bastions, strong and well built, and defended to the land by a wet ditch and glacis proper, and one face towards the sea with a raveline and double line of guns, and though there were but 59 guns in the fort there was room to mount 61. Opposite to this castle was a horseshoe battery of 12 guns, called Mancinilla In the middle between these two forts is a large shoal with not more than two or three feet of water in it, and in the passage on either side ships were sunk across to prevent the fleet getting by. Two miles further up on two flat sandy islands or keys stands the city of Cartagena directly on the sea, with Himani its suburb, back of it (east). Both are irregular figures, but well fortified to the land with strong bastions at proper distances with lakes and morasses running around them. The city was defended with 160 guns and the suburb with 140 and the water shoals on the sea side so as not to permit a close approach. East of the city about a quarter of a mile from the gate of Himani on an eminence about 50 or 60 feet high stands the castle of St. Lazar, which is a square of 50 feet with three demi-bastions with two guns in each face, one in each flank and three in each curtain. Its situation is very advantageous, overlooking all the town, though there is a brow of a hill about 400 yards from it that overlooks the fort as much, and entirely commands it."



SKETCH TO ILLUSTRATE ENGLISH ATTACK ON CARTAGENA IN 1741.

LUSTRATE ENGLISH ATTACK ON CARTAGENA IN 1741.

3 GUNS
PASA CABALLOS
8 GUNS
Ft. St. JOSEPH
BARA DERA
15 GUNS
CASTLE ST. LOUIS
Ft. ST. PHILIP
Ft. ST. JAGO.

741.

The reconnoitering ship advised landing at the same point as De Pointis had done and on the 6th Sir C. Ogle laid three ships of 80 guns each before St. Jago and St. Philip. Another 80 gun ship was placed against the fascine battery which proved to have no guns mounted, and a 50 gun ship against Chamba. Thus the guns opposed to each other were 6 to 1 in favor of the ships.

The Admiral, Vernon, with his division escorted the transports leaving the 3rd division to continue the feint on the other side of the city.

After an hour's bombardment the forts were shattered and abandoned and 500 grenadiers took possession of them, without any resistance. It was not possible to land more troops that night as they could not be brought from the upper side of the city owing to the wind. Two of the three ships off St. Philip and St. Jago suffered trifling losses, but the "Shrewsbury" had her cable cut by a Spanish shot and drifted before the trade wind into the concentrated fire of the main defenses at the harbor mouth besides that of the 4 ships inside the boom. After 7 hours firing, opposing 26 guns to 200, the "Shrewsbury" drew off at nightfall dismasted, with 240 shots in her hull. This does not seem good work on the part of the Spanish.

This same evening the bomb ketches were carried in to begin the bombardment of St. Louis. On the 12th the "Ludlow Castle" opened mortar fire on St. Louis, on the 13th the bomb battery on shore opened.

The army landed on the 10th, and till the 15th was occupied in landing tents, artillery stores and provisions so that during the first three days the troops were much exposed to the weather and fell sick. The camp was on low land, so placed as to be unseen by the Baradera battery yet in the line of Spanish fire from it upon the English bomb battery.

The Chief Engineer did not push his work as fast as the Admiral thought possible and thereupon a coolness sprang up between the two commanders-in-chief which spread among their subordinates until its effects on the campaign became very regrettable.

The Baradera battery continued to annoy the camp and it was resolved to destroy it, attacking at midnight with 300 blue-jackets and 200 soldiers. Bad weather delayed the expedition till the 19th at midnight, when it set out. It may be noted that one of the two

companies of soldiers was commanded by Captain Lawrence Washington, who afterwards named his estate in Virginia as Mount Vernon, in honor of the naval commander of this expedition. After pulling to leeward to avoid being heard, the boats landed about a mile below the battery and found themselves immediately beneath a 5 gun battery, hitherto unknown to them. After an instant's hesitation the officers carried the men forward and they pushed through the embrasures with very little loss. The Spaniards turned some of their guns in the main battery loaded with grape on the charging Englishmen, but firing high, the defense was ineffective. The guns were spiked, the battery set on fire, and all returned to their ships. The accounts record that "The Admiral was so pleased with this affair that he rewarded the common men with a dollar apiece."

The destruction of this battery gave great relief to the camp and enabled work to be carried on in more security upon the main battery in the wood. Although the engineers had 500 seamen and 250 negroes besides their own men, yet they failed to hurry matters in accordance with the expectations of the Admiral who was very anxious to get his ships inside the harbor, as the weather was very tempestuous and the stony bottom of the anchorage cut the ships' anchor cables. Besides which a French fleet was said to have arrived in the West Indies.

On the 20th, Fort St. Louis began firing against the bomb battery. On the 21st the battery destroyed at Baradera had two or three guns in service once more, greatly annoying the bomb battery and camp. The "Ripon" was detailed to anchor near and keep it quiet.

The Admiral now called a council, which resolved to make a brisk attack on the defenses. On the morning of the 21st, the main battery of 19 guns and the mortar battery of 30 pieces opened, to which the Spanish replied very generally. On the 23rd, Commodore Lestock with 6 ships closed with the fort, and was supported by Sir C. Ogle, who was to come in to replace injured ships, or extend the line if there was room for him. The "Boyne" failed to get her designed anchorage and suffered much, and left at night fall, after which the "Prince Frederick and "Hampton Court" which had done good service all day caught the fire previously directed against the "Boyne." Before morning it was necessary to order them away also. The other three ships were

less exposed, but were called off at night fall. The distance was too great for the ships' fire to be effective, but they drew part of the Spanish fire from the siege works.

The Baradera battery still annoyed the camp and on the 24th three ships were sent against it, while a detachment of sailors was landed and destroyed it again, after which they drew their boats overland and boarded and burnt a sloop that lay in the bight as a magazine for the battery.

By the 24th many guns had been dismounted in St. Louis and a breach well opened. The general therefore wished to assault on the 25th and after consultation with the Admiral it was arranged that the latter should attempt a diversion. The Admiral sent a party of blue-jackets who landed unopposed on the site of the ruined Baradera battery, drawing the attention of the Spaniards. At 5.30 p. m. the storming party advanced against St. Louis, covered by the smoke of the great battery's fire. The attack was successful and the fort was taken with the loss of one man. The whole assaulting force, including the reserve of 500 men, was only 1300 strong. Captain Knowles, in command of the blue-jackets at Baradera, observing that the Spaniards were in great confusion, owing to the loss of St. Louis, threw his men into their boats and boarded Fort St. Joseph. The Spaniards attempted to sink their ships, having previously prepared them, but Captain Knowles pushed on so quickly from St. Joseph that he captured the "Galicia," flagship, before she could be sunk.

It now remained only to destroy the boom in order to be able to enter the harbor. This was soon done by the boats and carpenters of the fleet.

The Army had lost 500 men by death from the climate and battle, and had besides about 1500 sick in the hospital ships. The Navy suffered less as not having been on shore. It seems beyond a doubt that it was a great sanitary mistake to land so many men to live in idleness while a few carried on the work against the fort. On the 26th the "Galicia" was towed out of the channel and several heavy ships managed to warp past the sunken and burning Spanish ships. On the 27th two ships got as high as Castillo Grande, while a detachment to Pasa Caballos cut off supplies to the city by that route. By Pasa Caballos was the water route to the Magdalena River by way of the canal, and this was the principal commercial highway. A good spring of fresh water was

found which the Admiral took possession of for the use of the fleet only. The lack of good water was largely responsible for the sickness in the army. The Admiral also refused to supply the army with fresh fish and turtle which were caught for the navy only. In short, the public service was sacrificed to the coolness between the two commanders-in-chief, which was imitated by the principal officers of both services.

The greater part of the forces was inside on the 30th of March, but Commodore Lestock remained with his division to complete the embarkation of the cannon and stores used before St. Louis.

As the English advanced up the harbor, the Spaniards blocked both channels abreast of Castillo Grande by sinking ships, while just inside they anchored their two remaining ships of the line so as to support either Castillo Grande or Mancinilla.

A naval council of war on the 30th decided that haste was desirable and that the remaining outer defenses of the city should be destroyed in order to land the army as near to the city as possible. As the ships moved to the attack, the Spaniards blew up Mancinilla as they thought it untenable, sank the two battleships and abandoned Castillo Grande.

This was discovered on the morning of the 31st when the Castle was manned by the Navy and an effort made to remove the masts of the sunken ships so as to clear a passage, but the working party found the stern of the " Conquestador " afloat and hove her round clear of the channel. By evening two bomb-ketches with two covering frigates had passed in, and on the morning of April 1st they opened fire. In the meantime the troop transports had come up.

On the 3rd and 4th some of the battleships worked through the obstructed channels into the Surgidero and arranged themselves so that the troops might land behind them. A fire of grape shot from these ships lasting all night drove the Spaniards from Pastellillo and cleared all the country side for the landing of the troops on the 5th. It is to be remarked how much the abandonment of Castillo Grande facilitated the work of the English army, as otherwise it would have been landed further from the city.

On the 5th of April at daylight 1500 troops were put ashore at Texar de Gracias (or Gratia), and marched through a narrow way between the shore and the tropical woods. They were opposed by

700 Spaniards, but the English drove them back and seized La Quinta (a country place) as a camp. La Popa was found unoccupied and was seized. On the 6th all the troops were landed, but for three days they were exposed to the weather without tents. General Wentworth reconnoitered St. Lazar and the city, and on his return a military council was held as to the propriety of attacking St. Lazar before some new Spanish works should be finished on the hill adjoining it. As no stores had yet been landed from the ordnance ships, no attack was made. In the meantime the Spaniards completed a four gun battery, and entrenched themselves in lines thrown up around the Castle (St. Lazar) itself. The guns of a fascine battery on the north point were also mounted in this new battery.

On the 7th another military council again decided not to assault St. Lazar without having first raised a battery, and requested the navy to send the bomb ketches (mortar vessels) and a ship of the line against the fort to facilitate its reduction. Admiral Vernon replied expressing his disapprobation of waiting to raise a battery, sickness was increasing, the rainy season was approaching, the Spaniards would not stand an assault, but their engineers were better than the British, wherefore Vernon and Ogle urged immediate assault, and sent ashore the marines belonging to the ships' complements, besides some American troops, bringing General Wentworth's force up to 5000 men.

Supplies and provisions continued to pass into the city from the north along the sea beach and this was a subject of dispute between the commanders-in-chief. The general could not send a detachment there, as he was without boats for supplying them, and the admiral promised, but did not send, frigates to lie off the strip of beach and control the passage.

On the 8th the military council again assembled and the engineer reported that in the circumstances of the army no time was available to carry on siege operations and that an assault must be made or the army should withdraw. The troops were paraded for an assault in two columns at 2 a. m., April 9, but in the darkness one column lost its way and assailed the most difficult part of St. Lazar, the other column lost its commanding officer and the guide, and stopped in consequence. Spanish reenforcements poured out from the city, but no ships were placed where they could command the bridge head behind St. Lazar, so that the result to the

English was only a loss of 650 men. On April 11th two mortars began to fire from the advanced guard, and on April 14th two ten inch mortars, landed and manned by the navy, opened fire from Manga Island. On the 11th another military council had decided that without a large reenforcement from the fleet nothing could be done. Sickness continued to increase while the water supply in the cisterns began to fall. The admiral treated the military council with rudeness and a general council was held on the flagship on the 14th. The admiral showed great heat and passion towards General Wentworth and the navy would not consent to land the sailors of the fleet, as Admiral Ogle said they could not be kept in hand, so it was resolved to reembark. The soldiers were now reduced to about 3500 men, many of these very feeble.

On the 15th the stores were embarked, followed by the troops on the 16th, but this day was selected by Admiral Vernon for an attack on the city by the "Galicia" prize armed with 16 12-pdr. and 18-pdr. guns. She did not get close to the city and after 7 hours was reduced to a wreck. She hauled off and got on a shoal to avoid sinking.

From this date, for over two weeks the bluejackets were occupied in destroying all forts, batteries, lime-kilns, etc., that had been captured. On the 6th of May, as an old historian puts it, "Vice Admiral Vernon very civilly left the harbor, not having injured any of their dwelling houses or given the least loose to any of those rapacious practices of war so often committed." On the 8th, the expedition sailed for Jamaica.

In reviewing this unsuccessful expedition the following points may be noted with advantage:

1st. More troops than were needed were landed at Boca Chica, causing sickness to be general when the final operations before the city were undertaken.

2nd. The general commanding failed to recognize that the climatic conditions were such that he could not save the lives of his troops by delaying for siege operations. The most bloody assault would cost fewer lives than a fortnight in trenches. This was clearly perceived by the admiral and his insistence upon the point caused bitter ill feeling between the military and naval officers of high rank.

3rd. The general did not push the Spaniards in haste, as is the proper way to deal with Spaniards. If he and his brigadier had

been enterprising, Lazar could possibly have been taken on the day of landing. Similarly, an error was made in landing all the troops before landing any stores, whereby the whole body of troops was exposed to the weather for several days.

4th. The admiral got into the lake on the 26th of March, but did not attempt any operation till everybody was in on the 30th. It is probable that the troops could have landed two or three days earlier if arrangements had been made to attack Castillo Grande with the first ships of the line to pass inside.

5th. The main cause of failure was the utter lack of cooperation between the army and navy after getting into the lake. The admiral thought, probably with reason, that the general was not doing as well as was possible and thereupon failed to cooperate with him, threw obstacles in his way and treated him with such rudeness that success was impossible.

In comparing these three attacks on Cartagena we shall perceive several particulars in which the operations were alike, and we may fix certain points in regard to tactics at that period, and later we shall see how time and progress have affected these matters.

In regard to the defense, we see that in each case fortified artillery positions to destroy the lives of the attacking forces are combined with channel obstructions to stop the advance of the ships (in the French attack the natural difficulties of the channel were thought sufficient to prevent passage under fire).

In regard to the attack:

In each case the main attack was made by a body of soldiers attacking the shore defenses of the place by the ordinary military methods of the time, and the navy supported the land attack without greatly risking its ships under the fire of the forts.

In each successful attack, there was a single commander-in-chief in charge of all the forces and their operations. In the unsuccessful attack there were separate commanders-in-chief for the army and navy, and to the lack of harmony between these officers the failure was directly due. It is therefore proper to examine how this divergence of views arose and what lessons may be drawn from it. The first difficulty arose before Boca Chica when the admiral told the general in a very disagreeable manner that the engineers were not pushing their siege works as fast as

they should and that an early assault was necessary. The general resented this reflection, and cordiality and cooperation between the army and navy were lacking more and more as the operations were prolonged. The general was unable to see that under the unjustifiable form of a rude and contemptuous criticism upon the engineers the admiral was really making a report upon the condition of affairs as affecting his own ability to support the besieging army. The general looked upon the arrival of the French fleet and the approach of the bad weather season as difficulties which should trouble his colleague only, and refused to admit that they concerned him as seriously, if not as directly, as they did the admiral and that they were the factors which gave the admiral the right to urge the early assault. Of course, after the two commanders had lost their tempers and refused to aid each other success could not be hoped for. But in the beginning both had been desirous of the success of the national arms, and if they had had a good understanding of each other's situation the operation would have had every chance of success. Unfortunately the general's lack of acquaintance with the science of war caused him to be unequal to the practice of its art so soon as he found himself confronted by a situation beyond the limits of his previous personal experience.

For the United States army and navy, it is only reasonable to believe that a study of previous campaigns and a general knowledge of each other's situation and requirements will enable our commanders-in-chief, in joint operations, to perceive in each case which should take the lead, and which should follow suit, and so to play a united and successful game.

Attack upon the French Fleet in Basque Roads in April, 1809.

To illustrate the turning of a fortified position, regarded by Napoleon as impregnable.

Late in February, 1809, the French fleet at Brest eluded the British blockading fleet, with the intention of operating against the British colonies in the West Indies after uniting with several small detachments. The French squadron went to L'Orient and picked up the ships blockaded there, and then made for Isle d'Aix to liberate the Rochefort squadron. They made a junction with the latter, but finding Admiral Stopford in the vicinity with 4

ships of the line, the French fleet put into Basque Roads and later withdrew into Aix Roads where Stopford blockaded them with 7 ships. On March 7th Lord Gambier, commander-in-chief, with 5 ships of the line, joined Admiral Stopford, so that the British force was now superior.

In this state of affairs the British Ministry was very anxious to gain some advantage over the French fleet, but Lord Gambier did not care to attack. He wrote home that the fortifications on Aix were no obstacles to bombarding the enemy's fleet if the admiralty wished to destroy it. He further said: "The enemy's ships lie much exposed to the operation of fire-ships; it is a horrible mode of warfare, and the attack hazardous if not desperate, but we have plenty of volunteers for the service. If you mean to do anything of the kind it should be done with secrecy and quickly."

Hereupon the First Lord of the Admiralty sent for Captain Lord Cochrane and showed him the Commander-in-Chief's letter, saying that the ministry was unwilling to order an attack by fire-ships. In other words, the Ministry wanted a victory, but required a scapegoat in case of defeat, and invited Lord Cochrane to submit a plan.

Lord Cochrane thereupon submitted a plan which the First Lord approved, and asked him to carry out. Cochrane declined to do this on the ground that being a very junior officer and an outsider, it would excite much jealousy in the fleet, and moreover Lord Gambier might not be satisfied to put another's plan in execution. The First Lord then endeavored to find some one else to execute Lord Cochrane's plan, but the next day told Cochrane that he should go to Basque Roads and that "the Board of Admiralty would so manage with Lord Gambier that the *amour propre* of the fleet should be satisfied."

On March 19th the Admiralty notified Lord Gambier that it was sending out 12 fire-ships besides rockets and a detachment of marine artillery, and suggested that the admiral attack the French fleet offering him all reenforcements and facilities he might wish.

On March 26th Gambier replied describing the position of the French fleet:

"The enemy's ships are anchored in two lines very near each other in a direction due south from the Isle d'Aix and the ships in each line not further apart than their own length, by which it appears, as I imagined,

that the space for their anchorage is so confined by the shoalness of the water as not to admit of ships to run in and anchor clear of each other. The most distant ships of their two lines are within point-blank shot of the works on the Isle d'Aix; such ships therefore as might attack the enemy would be exposed to be raked by red-hot shot, etc., from the island, and should the ships be disabled in their masts, they must remain within range of the enemy's fire until they are destroyed—there not being sufficient depth of water to allow them to move to the southward out of distance. The enemy having taken up their position apparently with the view not only to be protected by the strong works on the Isle d'Aix, but also to have the entrance to the Charente open to them, that in case of being attacked by fire-ships and other engines of the kind, they can run up the river beyond the reach of them. The tide and wind that are favorable to convey this kind of annoyance to the enemy serve equally to carry them up the river."

The letter concluded with the information that the Commander-in-Chief was ready to execute any plan of attack that the Admiralty might direct.

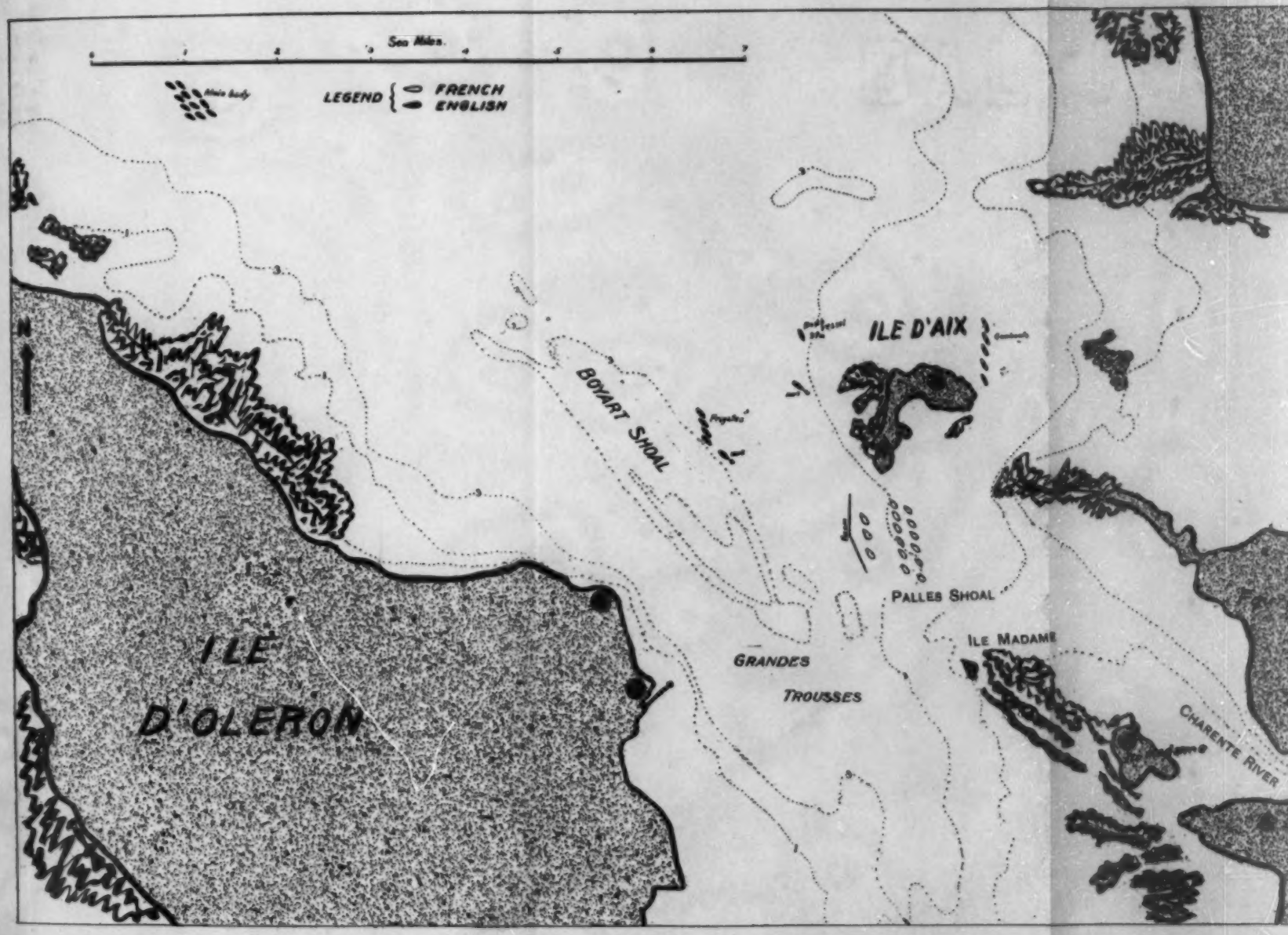
It is to be noted that the admiral had changed his opinion as to the obstacles offered by the Aix defences.

Upon the arrival of Lord Cochrane on April 3rd with orders to Lord Gambier to permit him to carry out his plan, the ill-feeling in the fleet became very great and Admiral Harvey used such language in public to and of the Commander-in-Chief that he was afterwards court-martialled and dismissed from the navy, but was immediately restored in consideration of his previous good record.

However, Lord Cochrane urged the Commander-in-Chief not to wait for the fire-ships from home to fit out others in the fleet. Three explosion-vessels were also fitted out, this being a novelty introduced by Lord Cochrane. These ships contained 1500 barrels of powder covered over with several hundred shells and three thousand hand grenades.

On April 10th the fire-ships from England arrived so that there were available 20 fire-ships, and three explosion-vessels. The situation occupied by the French may now be described.

The Ile de Re and the Ile d'Oleron form between them a deep arm of the sea whose entrance is about 7 miles across. At the bottom of the bay is the entrance to the Charente river, on which, several miles from its mouth, is the city and naval arsenal of Rochefort. The Ile d'Aix, off the entrance to the river, affords a site for an outwork to defend the river entrance and at the same time protects the anchorage of Aix Roads. Ile Madame is on the other



SKETCH ILLUSTRATING ENGLISH ATTACK ON FRENCH FLEET IN BASQUE ROADS IN 1809.

NGLISH ATTACK ON FRENCH FLEET IN BASQUE ROADS IN 1809.

OADS IN 1809.

side of the entrance to the river, 2 miles from Ile d'Aix. The tides run strongly and rise at springs to a height of 21 feet.

The English fleet was anchored within the shelter of the islands in Basque Roads, but at a respectful distance from the fortifications, while the French fleet had taken a position as far to the front as it dared, in order to lose no time in warping out of the river should bad weather drive away the blockading force. This position was taken by the personal order of the Emperor Napoleon, whose opinion as to the locality had been expressed 4 years previously to the Minister of Marine as follows:

"You may quiet your apprehensions that the enemy will attempt something against Ile d'Aix. Nothing can be more insane than the idea of attacking a French squadron at Ile d'Aix. I am annoyed to see you with such notions. What on earth do you imagine is to be feared by a squadron of 5 ships of the line, with plenty of powder and supplies, well protected, and ready to fight lying at Aix?"

The French fleet moored in three lines with their heads northerly, the lines resting on Ile d'Aix and running south therefrom. The lines extended far enough to rest on the Palles Shoal.

In the two inner lines were the battleships and one frigate, 6 ships in each line, and the third line had 3 frigates about 750 yards in front of the battleships. About one-half cable's length in front of the frigates was a floating boom of very unusual size and strength about 1600 yards long. Ile d'Aix had several batteries whose strength is not exactly known. It is probable that not more than 30 guns covered the French Fleet, but they were 36 pdrs. (large guns then) and there were several mortars of the largest size. The N. E. side of the island had only a few guns and those in poor condition. The garrison consisted of 2000 recruits.

On the Ile d'Oleron were three or four gun and mortar batteries, one of which could almost intersect its fire with Aix batteries. The Boyart shoal reduced the area available for maneuvering ships. The batteries on the Isle Madame, at Fouras and elsewhere did not come into action.

The arrival of the English fire-ships was a warning to the French fleet that an attack was to be expected. The French admiral therefore issued a general order covering the preparations for defense. The battleships sent down their light yards and unbent all unnecessary sails so as to have as little inflammable material aloft as possible. The ships' soldiers were also to be

ready to land on Ile d'Aix in case the English should try to take possession. Moreover, the boats of the fleet, 73 in number, in 5 divisions, were ordered to assemble at the boom each night to board and tow away the fire-ships and engage any British boats supporting them.

On the afternoon of the 11th of April the English fleet began to take up positions for the attack. The line of battle remained at anchor about 8 or 9 miles from Ile d'Aix and the attacking force moved up. It consisted of the 20 fire-ships, 3 explosion-vessels and a supporting division of 4 frigates all under the command of Captain Lord Cochrane.

The frigates anchored near the head of the Boyart shoal a gun shot and a half (about a mile and a half, or three quarters) from the French. Here they were to wait to receive the escaping crews of the fire ships.

The "Etna" carrying a 13 inch mortar, the only bomb vessel which had arrived, took station N. W. of Ile d'Aix and was covered by two light craft. Five gunboats were stationed to make a diversion at the east end of Ile d'Aix and two brigs with lights screened from the enemy were stationed as markers to guide the attacking vessels. At 8.30 p. m., the fire-ships got underway with a strong flood tide and a N. W. gale. Many of them were fired and abandoned too soon, before they had even passed between the mark boats. The boats of the fleet had been ordered to assemble alongside the Caesar ready to support the fire-ships, but the weather was so bad that they did not leave her. For the same reason the French boats could not get at the boom.

Lord Cochrane personally conducted an explosion-vessel which blew up against the boom about 100 yards from the frigate "L'Indienne" and soon after a second one did the same, and several fire-ships then pushed on to the French anchorage. On seeing the flaming ships coming on, the French fleet opened fire with little regard for its own frigates in the outer line which had to slip their anchors. It was disputed whether the explosions destroyed the boom by the great wash they raised or whether a very heavy fire-ship tore it adrift, but, however that may be, the boom disappeared, while the explosions threw the French ships into panic as every fire-ship was thought to be an explosion-vessel.

The Frenchmen cut their cables in a wild effort to get into the Charente River and avoid the five or six fire-ships which had been

well handled. Two French ships were fouled by the fire-ships although their crews saved them. But the French had unbent their sails and the night was dark and stormy. By midnight all the French ships except two were aground and some were much damaged by the bottom and by fouling each other.

In the morning at daylight Lord Cochrane signalled the condition of the French fleet, but the admiral 12 miles off made no move to destroy the helpless enemy who were seen to be making great efforts to get afloat. At 10.45 the English fleet got underway, but anchored out of gun fire of Aix. But Lord Gambier ordered the mortar vessel with a couple of supports to take position to bombard the French ships while he sent a division of three ships of the line to move into a position of readiness, so these ships advanced a mile.

This induced the two French ships not aground to get underway for the mouth of the river, where they also got ashore. Before high water 4 ships got afloat and moved towards the mouth of the river, but all grounded again in the mud.

Hereupon Lord Cochrane about 1 p. m. made a series of reports by signal; but as they produced no movement by the British Admiral, Cochrane lifted his anchor and allowed his ship, the "Imperieuse," to drift upon the French fleet with the idea of forcing his chief to support him and destroy it. After getting within range he signalled "this ship is in distress and needs assistance immediately." Shortly after he anchored and opened fire on three ships. A little later Lord Gambier sent in the frigates; and in explanation at his court-martial testified that it was "unnecessary to run any further risk as the object of their destruction seemed to be obtained."

At 3.30 p. m., two ships of the line reported to Cochrane and a crescent line of English frigates was formed around the grounded ships on the Palles Shoal. The "Valiant," one of the ships of the line, signalled to the admiral "No doubt 5 more may be destroyed tonight." The answer was a recall. Three ships captured and one burnt was the result of the day's work.

Three transports were hastily converted into fire-ships and with Rear Admiral Stopford on the "Caesar" they ran under the fire of the Oleron batteries late in the afternoon. The "Caesar" and "Valiant" grounded on the end of the Boyart shoal but got off as the tide rose and then the division got into Grandes Trous-

ses anchorage. It was midnight before the fire-ships were ready and then the wind shifted so as to prevent attack and Stopford went out again, leaving Cochrane in the "Imperieuse." The captured ships were set on fire at this time, so that they were mistaken for a new attack of fire-ships and the French opened fire on them and one captain even set fire to his own ship and abandoned her, but such was the excitement that it was badly done, and the fire went out, so in the morning he and his crew returned to her.

At 8 a. m. Cochrane with the small craft present renewed the attack without orders, but he could not get his two frigates up on account of the wind and tide. On the 14th four French ships got up the river beyond all danger and Lord Gambier sent Lord Cochrane to England.

Thereafter, to the great astonishment of the French, no further efforts were made by the English. On the 17th only one French vessel, the "Regulus," remained outside and she was near Fouras in a position easy to attack. On the 20th a newly arrived mortar vessel attacked the "Regulus," but she soon burst her only mortar. On the 29th, that is on the second spring tides since the disaster, the "Regulus" got inside and Lord Gambier sailed for England.

Napoleon's opinion on the matter was that "the French admiral was a fool and the Englishman just as bad. Had Cochrane been supported he would have taken every one of the ships."

The spirit of the French navy which was just beginning to revive after Trafalgar was destroyed by this affair, and in the opinion of some French officers this was its most serious effect. Until the end of the war five years later no important movement was undertaken by the French navy after this crushing blow.

The lesson of this operation is the great use which may and should be made of auxiliaries. Although the particular method used is no longer applicable under present conditions, yet we should spare our battle ships now, as Gambier did then, but not as he did when the time to use them had arrived. In this case, the French were anchored in a carefully chosen position, flanked by shoals and an island, so that only a frontal and disadvantageous approach was possible for the enemy. In front of the French line, the boom prevented the English ships from coming to close quarters and boarding.

By the attack of the fire-ships and explosion-vessels, the French defensive formation was completely broken and the individual ships exposed to destruction.

Lord Gambier's unenterprising character deprived him of much of the fruits of success, but the whole affair is not the less instructive.

The Expedition to Flushing in 1809.

A mistake as to the key of the situation.

In the spring of 1809 France was engaged in war against Europe and was carrying on two principal campaigns, one in Spain and one in Austria.

The Emperor of the French was desirous of re-establishing his navy in order to break the continental blockade maintained by England. He had established a great naval dockyard at Antwerp on the River Scheldt, and forced Holland to cede to France by treaty the port of Flushing and the mouth of the west branch of the Scheldt. This gave him a harbor of refuge at the mouth of the river whence his fleet could depart without delay and besides it offered the advantage of an auxiliary dockyard in an advanced position. After the disaster of Basque Roads, the only active French fleet lay in the Scheldt where it was a menace to the English West India trade. In this condition of affairs the English Ministry planned a combined operation against the French fleet in the Scheldt, hoping to accomplish two objects, that of relieving the West Indies from all fear of attack and thus easing the work of the blockading squadrons, and that of requiring the Emperor to despatch French re-enforcements to Belgium instead of to Spain and Austria.

But the very fact that a powerful English army was maintained in Spain rendered it difficult to arrange for the Netherlands expedition; and owing to the consequent delay and newspaper publicity the expedition was as closely followed in Paris as in London. The French successes in Austria, releasing the armies there, rendered the expedition to Holland unadvisable, as no Dutch uprising in its aid could then be expected; but obstinacy decided the Ministry to persevere and the expedition, whose organization began early in May, sailed from its rendezvous in the Downs on July 28, 1809, consisting of 37 ships of the line, of which four-fifths had their lower deck guns out and their holds prepared as horse transports, 88 frigates and smaller craft, 120 hired armed vessels and 400 transports measuring 100,000 tons, carrying 39,000

men, including 3000 cavalry, under the commands of Rear Admiral Sir Richard Strachan and Lieutenant General the Earl of Chatham.

The instructions to the expedition were to capture or destroy the whole of the enemy's ships afloat in the Scheldt or building at Antwerp, to demolish the dockyards and arsenals at Antwerp, Terneuse and Flushing and if possible to render the Scheldt no longer navigable for ships of war.

In the summer of 1809 there were at anchor in the West Scheldt above Flushing ten French seventy-fours, under Vice Admiral Missiessy. There were also several ships of the line building in various degrees of completion at Antwerp. Since the disaster at Rochefort, the Ministry at Paris had urged Missiessy not to lie off the entrance to the Scheldt, but to retire to Flushing. Missiessy dreaded the certainty of the annual outbreak of fever in the island of Walcheren more than the possibility of fire ships and received permission to manoeuvre in the Scheldt in case the English should approach.

Although the expedition was known to be fitting out, the authorities in Paris and in the Netherlands had made few preparations. When the English forces were sighted the country was very weakly garrisoned, a few hundred only for the great and powerful defenses of Antwerp, 4000 in Walcheren and as many more in Bruges and Ghent, cities 20 miles south of the Scheldt. Everything therefore was for the moment in favor of the English, but the French peace with Austria rendered the utmost haste imperative to insure success.

On the departure from England it had been arranged that the left wing of the army, 13,000 strong, covered by a division of ships of the line should land on the sea side of Walcheren and take possession of the sea coast forts at Flushing. Another division, 5000 strong, was to land on Cadsand and take the battery at Breskens. When the entrance to the West Scheldt should be safely held the bulk of the expedition expected to sail up the river and land near Santfliet above the junction of the two branches.

On the 29th the English fleet was seen by the French lookouts, the French fleet lying at the time behind Flushing and word being telegraphed (semaphore signals) to Paris and Vienna, conscription was made for new levies and the country was stripped of

troops to provide a garrison for Antwerp. The English troops could not be disembarked immediately on account of unfavorable weather, so the expedition waited for a change. But as the weather did not change and as it was learned that the French fleet had not retired to Antwerp, it was decided to send the main body to turn the position at Flushing by proceeding as far as possible up the East Scheldt and then landing on North and South Beveland, they were to march to the East end of South Beveland and seize Bathz, thus cutting off the French fleet. At the same time, the Walcheren force was sent into the channel east of Walcheren to land in quiet waters. All this took time, and after landing, Veer was bombarded by land and sea, and it was August 3rd before Flushing was invested.

The French general on the south side of the Scheldt had 300 men at Cadsand and he ran them about like stage soldiers to impress the English imagination while he summoned his troops from Ghent where they had been cantoned to avoid fever. That night the French troops all got drunk and the general and his staff were the only available force, but the English had been alarmed by his display and could only land 700 troops at a time, so they unwisely waited for more boats which were needed elsewhere also, and could not come. By noon of the 30th, French re-enforcements of 1500 men had arrived from Ghent, and on August 1 the English force off Cadsand, which foolishly had done nothing, moved around Walcheren and followed the rest of the army. The general commanding at Cadsand, being relieved from fear of debarkation in his neighborhood threw all his re-enforcements as they arrived across into Flushing, doubling its garrison. Although some disconnected attempts were made by junior English naval officers to cut off the passage of these re-enforcements it was not until the 6th of August that Flushing was finally cut off from its communications with Cadsand; yet the cordon of English ships around the island had been complete for several days before, except at the most important point abreast of Flushing.

While half the English army prosecuted the siege of Flushing the rest spread over South Beveland and seized Bathz, closely supported by the naval light craft. The Dutch forces had little interest in supporting Napoleon, and retreated without resistance. The French fleet which the English troops hoped to cut off at Bathz easily moved up the river before them and when the Eng-

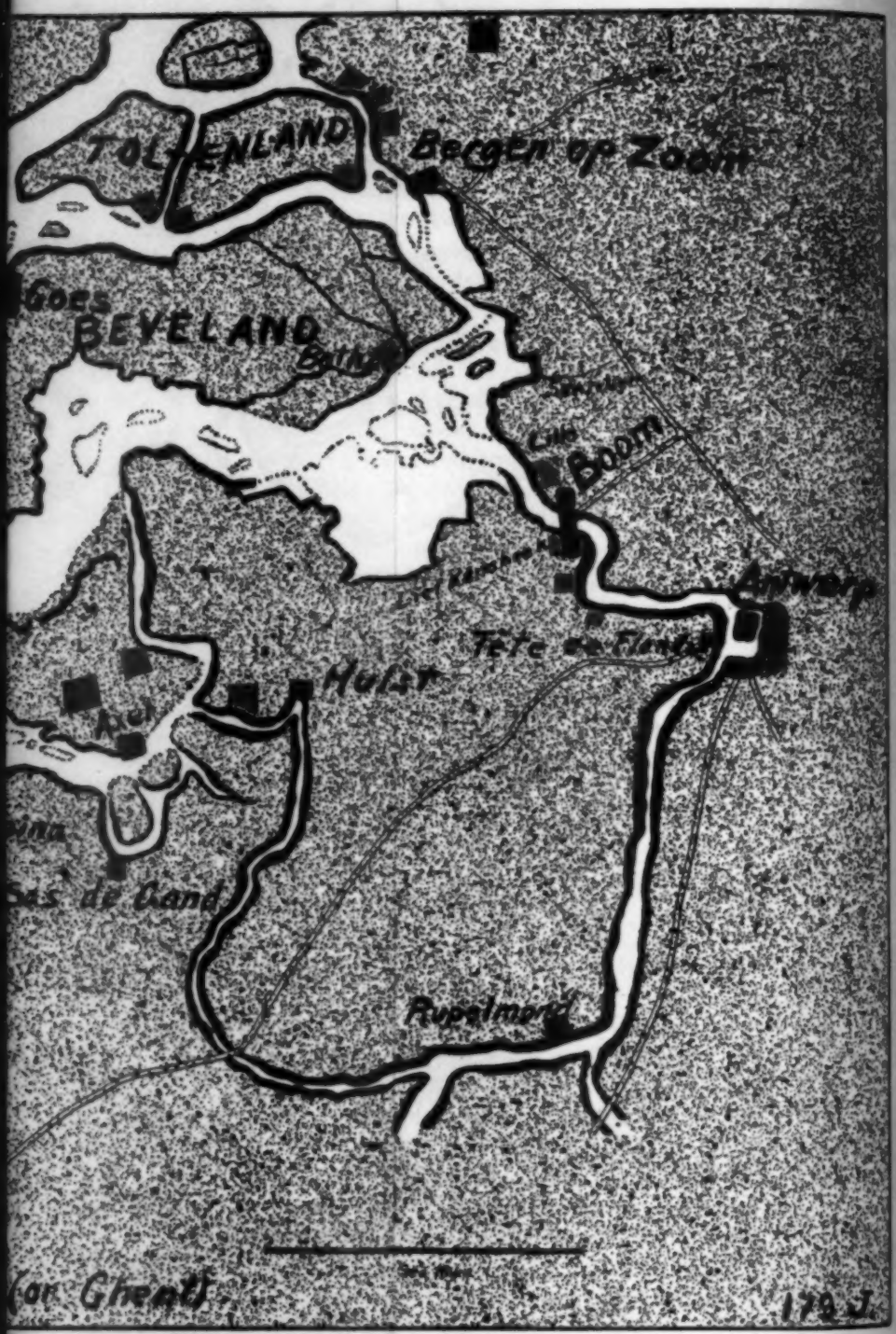
lish took Bathz on the 2nd, the French fleet had retired behind the fort and boom at Lillo, leaving a flotilla of light craft to annoy the English at Bathz.

On the 9th a light division was sent to sound in the West Scheldt off South Beveland where it arrived by following the channel east of Walcheren, and on the 11th a re-enforcement of ten frigates ran in between Flushing and Cadsand but, although under fire for two hours owing to the light wind, the squadron lost only 2 men killed. During this time, the French garrison at Flushing had kept up a very active defense which cost it severe losses and did not much delay the construction of the English batteries. On the 13th the English batteries of 52 heavy pieces near Flushing opened fire, on the defenses, supported by two divisions of bomb and gun vessels, one on each side of the town. The wind prevented the line of battle ships from getting up till the next day, when two of them grounded. The others hauled off and those aground followed them as soon as they could get afloat. The French fire ceased on the 14th, but the English continued theirs and the next day terms were arranged, but on the 16th the surrender was completed.

The English army and navy had a total force of 80,000 men and their aggregate loss by battle had been 112 killed and 500 wounded. On the 18th of August the French had at Antwerp 12,000 troops with 4 field pieces, but the fixed defenses of Antwerp were still without ammunition.

Although Flushing surrendered on the 16th, Lord Chatham remained there till the 21st of August, when he crossed to South Beveland. On the 19th the local fevers developed in the army. The Commander-in-Chief decided to leave 10,000 men in Walcheren and thus had 28,000 available for the execution of his instructions, namely to reduce Lillo, Liefken-Shoek and Antwerp, and then seize the French fleet. He now learned, however, that the garrison of Antwerp had been re-enforced to 35,000 men and that the French fleet could proceed 5 miles above Antwerp to Ruppelmond and by removing guns and stores there they could go 15 miles beyond that to Dendermond, a fortified town. While Chatham, in conventional fashion, had been knocking at the front door the French had been pouring troops into Antwerp by the back gate. On August 26th a council of war decided to withdraw, and on September 4th all the English forces withdrew below

SKETCH ILLUSTRATING THE EXPEDITION AGAINST WALCHEREN IN 1809.



EDITION AGAINST WALCHEREN IN 1809.

Bathz. Flushing was garrisoned and retained and the rest of the forces withdrew. In December, 1809, as the healthy season began, Flushing also was abandoned, obliging the blockading squadron to face the winter gales outside of the fort instead of at anchor off Flushing, where fire ships would have been the only danger and might have been guarded against.

This expedition was ill planned, because it was started without sound information as to the navigation of the river or the state of its defenses. It was ill timed, as taking place during the sickly season which prostrated 14,000 men. It was ill managed, as being placed under command of a general who thought more of his own dinner than anything else connected with the expedition, and was of a very dilatory disposition, devoid of ability. The navy, better led, seems to have supported the army as well as could be expected, and its delays at various critical times are attributable to the weather.

Let us now examine what might have been done. Sir E. Codrington, a distinguished British naval officer, who was present, in a letter of August 20th, from Bathz, says:

"Had a small force been left to invest Flushing while all the rest of the army accompanied by all the flotilla of gunboats pushed on to Bathz, crossed there and reached Antwerp immediately, they would have been before Antwerp on the 4th of August when no more than 4000 French troops were there. The English fleet could only advance as fast as the army occupied the shores."

On the other hand, a French military writer points out, that in his opinion

"Blankenburg, 8 or 10 miles below the entrance to the Scheldt, was the proper place to disembark and take the great paved road for Antwerp, 26 leagues distant, passing through the cities of Bruges and Ghent, and throwing a heavy outpost to Courtrai southwest of Ghent. In this way the English might have appeared in great force opposite Antwerp at the fort known as Tête de Flandre in three days after landing and without having met any opposition and there is no doubt that the city would have fallen immediately. In the meantime the navy could have seized Cadsand batteries and entered the river at its leisure, chasing the French fleet up the river, where the army would have met it and prevented it from escaping up the Scheldt. The presence of the navy and the reduction of all defenses on the river would have secured the retreat of the army in the face of the gathering French forces, after the accomplishment of the objects of the expedition."

In reviewing this expedition, it is first to be noted that the Ministry was wrong in directing this great force upon Belgium. For a year past, England had been making great effort to sustain the insurrection in Spain, and the troops diverted to Belgium would have served to double Lord Wellington's forces present at the victory of Talavera, fruitless owing to lack of men to extend his line of operations. Putting this point aside, and considering the conduct of the Walcheren expedition it is apparent how entirely Lord Chatham misconceived his task. The object was to destroy the French fleet. The actual destruction was the proper duty of the English fleet, but the army should have prevented the French fleet from escaping. This should have been done by seizing two points, the great stronghold of Antwerp which might shelter the fleet, and the town of Ruppelmond where the river shoaled. As the ships had to take their guns out to pass Ruppelmond, it is obvious that a field force could retain them at this point. Instead of pursuing this course, Lord Chatham besieged Flushing, a point which was no real obstacle to the joint pursuit of the French fleet. By the time Flushing yielded, Antwerp had made good her powers of defense, fever was destroying the English army, and the French fleet was safe behind Antwerp.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

COLLIERS AND COALING STATIONS.

By Lieut.-Com. A. P. Niblack, U.S.N.

The question of the distribution and defense of coaling stations is pressing and vital at the present moment, not because the Bureau of Equipment, or the Navy Department itself, is less keenly alive to its importance, but because of the check given to it by the failure of Congress to appropriate money for coal depots for the fiscal year 1904, and the allotment of only $600,000 for the fiscal year 1905. We have no definite policy, and worst of all, in the service itself, opinion seems to be somewhat at sea on the question. As other countries have definite ideas, a frank discussion of our resultant disadvantage is, at least, timely.

Are coaling stations "beyond the seas" merely a time-of-peace convenience, or are they a necessity for war purposes? Unless extensively and expensively fortified, will they not serve in time of war as a base of supply for an enemy? How many stations should we have, and how much will they cost? Which arm of the service will garrison them? Are we really sure that coal will not be supplanted by liquid fuel? Are not ordinary colliers, to accompany our ships or to meet them at given points, all that we will require in time of war, or should the navy build its own specially designed colliers, and if so, how many are needed?

The Storage of Coal.

The annual consumption of coal for ships of the navy is about 350,000 tons. We can evidently figure on a half million tons as the normal demand for the future. It would seem advisable to store coal at given points to meet this demand (1) on account of the type of furnaces in men-of-war requiring the best kind of coal;

(2) the commercial demand in the open market is for inferior and cheaper grades; (3) on account of unforeseen strikes; and (4) on account of the difficulty of accumulating coal hastily when war is threatened. This brings us squarely up to the advisability of maintaining modern, up-to-date coal-storage and coal-handling plants at various points, not only as a commercial proposition, but as a war measure. As coal deteriorates in storage, there must, of course, be a nice balance between the consumption in time of peace and a reserve of not too old coal for war purposes. The French Government carries a stock of about 200,000 tons at Toulon, and Great Britain about the same amount at Malta.

Scientific coal handling means a saving in time, and is closely connected with the consideration of efficiency in ships of war, because, while coaling, a man-of-war is practically off station. The day has passed when storing coal in the open air and handling it by shovel and cart can be considered as anything else than a makeshift. In considering the establishment of coaling stations, we must recognize the fact that the mere cost of the storage and handling plant is but a small part of the initial expense, because fortifications are an integral part of a coal base for war purposes, unless we contemplate furnishing coal to an enemy.

WHAT IS BEING DONE.

We have, in our navy, the colliers Ajax, Saturn, Arethusa, Brutus, Sterling, Caesar, Nero, Nanshan, Abarenda, Hannibal, Leonidas, Lebanon, Justin, Southery, and Pompey. These we have inherited from the war with Spain in 1898. At the present time we are about to build two specially designed colliers.

We have on the Atlantic coast facilities for about 125,000 tons of coal in modern coal-storage and coal-handling plants, as follows:

At Frenchman Bay, Maine, we have a 10,000 ton modern, up-to-date station, with a 250,000 gallon standpipe for fresh water, and the army has undertaken the fortification of the entrance. Additional coal room is needed, as this our northernmost station.

The Navy Yard, Portsmouth, N. H., is a minor station with a modern plant of 10,000 tons of coal, with ample fresh water supply and with good fortifications.

The Navy Yard, Boston, Mass., has a small, modern plant for 12,000 tons, with six coal barges, and it is planned to have a 50,000 ton station in Boston Harbor inside of the fortifications.

Narragansett Bay, R. I., has an ideal plant with a capacity of 40,000 tons of coal, twelve coal barges, and a 260,000 gallon water supply, all behind excellent fortifications.

New London, Conn., has a modern 10,000 ton plant, with plans for an additional 15,000; has ample fresh water; and the fortifications are those of the eastern entrance to Long Island Sound.

The Navy Yard, New York, N. Y., has a small, modern, 9000 ton plant, with a further extension unappropriated for. It is rediculously inadequate, but the argument is that good coal can be bought in the open market, which is not always the case.

The Navy Yard, League Island, Pa., is a secondary station, with from 3000 to 5000 tons capacity, intended principally for colliers.

The Navy Yard, Washington, D. C., has a 3000 ton supply, principally for time of peace.

At the Navy Yard, Norfolk, Va., practically nothing has been done, but a 50,000 ton plant is proposed for York River, Va., near Yorktown.

Port Royal, S. C., is to be retained as a coaling depot only. It has a storage capacity of 5000 tons, and an additional 15,000 ton plant is contemplated.

No serious plans have been made for the Navy Yard at Charleston, S. C., for other than local supply, as Port Royal will answer all purposes.

At the Naval Station, Key West, Fla., 20,000 tons are available, and at Dry Tortugas, Fla., also 20,000 tons, these two stations being only 60 miles apart, connected by submarine cable, and regarded as practically one station. Dry Tortugas is to be fortified. Key West is already well fortified.

The Navy Yard, Pensacola, Fla., has a small, 5000 ton plant, which is utterly inadequate.

At the Naval Station, New Orleans, La., a large appropriation is available, and outside of a small depot for local needs, it is probable that a large station will be erected somewhere inside of the fortifications at the mouth of the Mississippi River. Pensacola and New Orleans are regarded as practically alternate stations for the same region.

Plans have been drawn for a small coal-handling plant at Bahia Honda, Cuba, and it is proposed to have a 100,000 ton coal-storage and coal-handling plant at Guantanamo, Cuba.

At San Juan, P. R., there are now facilities for 36,000 tons of coal in the open air, but no modern appliances for handling it.

On the Pacific coast it is contemplated having about 200,000 tons available for war, but we are ridiculously short of this amount.

A 20,000 ton plant is contemplated for San Diego, Cal., now that fortifications are well assured.

At the Navy Yard, Mare Island, Cal., there are facilities for 20,000 tons, and six barges. It is contemplated building a 100,000 ton plant in San Francisco Bay.

The Navy Yard, Puget Sound, Wash., has a modern 20,000 ton coal-storage and coal-handling plant.

Sitka, Alaska, has a modern 5000 ton plant, which can be easily increased to 10,000 tons.

A small station is contemplated at Dutch Harbor, Unalaska, and a large plant at Kiska Bay, Aleutian Islands.

Honolulu, T. H., has a temporary coaling station with a capacity of 30,000 tons, but it is anticipated that a larger and more important station will eventually be asked for at Pearl Harbor. Steps are being taken to fortify the Island of Oahu.

The Naval Station, Tutuila, Samoa, has facilities for 5000 tons, and there are plans for a 25,000 ton station, the harbor to be fortified.

At the Naval Station, Guam, there is a collier and a small amount of coal, but there are plans for a 25,000 ton plant and extensive fortifications.

In the Philippines, there is a 30,000 ton modern plant at Cavite, and plans for a 100,000 ton station at Olongapo. Coal is kept stored also at Isabela, Polloc and Cebu.

We thus see that up to the present time most of the work is yet to be done, and, without considering the need for coaling stations on foreign soil, modern, up-to-date coaling plants are needed at many stations, and additional storage facilities at many others. There is, however, another question that should be settled during the lull in activities.

THE QUESTION OF FUEL.

It is high time that we were deciding definitely as to liquid fuel. The attitude of Italy on this question is instructive. Over ten years ago, with no crude oil, and no coal other than lignite of poor

quality within her borders, she met and promptly solved this question. Practically all of her ships were fitted to burn coal primarily, but with crude oil as an auxiliary, to be used (1) in getting up steam quickly in emergencies, and (2) for emergency full speed firing when coal comes slowly from bunkers and sustained high speed is killing on the coal passers. She built large tanks at her fortified stations, and kept them full of oil. To save large expenditures for distilling and to make up lost water from using steam to spray the oil, she built water-tank steamers to help save fuel when opportunity offered. Italy's fleet is essentially for coast defense, and high speed with limited fuel radius is a requirement of her double coast line with small area.

For more than ten years our naval attachés have reported the status of the liquid fuel question in all navies, and yet we spent thousands of dollars recently to find out that "the available supply of the world's production of petroleum that could be used as a fuel would not meet 3 per cent. of the world's demand for coal and other combustibles." That really has no bearing on the question of liquid fuel in our navy. Italy solved the question properly when the visible supply did not have the additional oil fields of Texas, California, and other recently developed areas.

Liquid fuel is a helpful auxiliary to coal. It utilizes the advantages of both. Several accidents to German battleships, or, more accurately speaking, several reported "close calls" have seemed to point to a danger or disadvantage in such use, but the German liquid fuel is an inert earth oil or tar called *mazut*, and it is stored in the double bottoms. The Oceanic Steamship Company's steamer Alameda, plying regularly between San Francisco and Honolulu, has a liquid fuel installation that is far in advance of anything before attempted and seems to have solved the danger question very successfully. Its merits are, from a naval standpoint, no double bottom storage; superheating or vaporizing directly at the burner, using either steam or compressed air for spraying (both fitted); isolated tanks with perfect steam smothering; and the avoidance of explosive gases by the accidental mixing of air and old vapors in receptacles. All this sounds alarming enough, but, contrary to the usually-wrong popular idea, there is less danger from oil as a fuel than from coal, and the precautions with oil are more easily taken than in the case of either coal or coal briquettes. Abroad coal briquettes are much used in men-of-

war in reserve bunkers, and they are not only more dangerous than crude oil, but they produce sores on those handling them and require safety lamps and goggles for the men working in the bunkers. The important inferences from the foregoing and from the Alameda's installation, as applied to men-of-war, are that (1) all men-of-war, including torpedo boats and destroyers, should be fitted with auxiliary burners, using compressed air so as not to waste fresh water, and because compressed air is usually available in emergencies in connection with torpedo outfits; (2) crude oil should have separate isolated tanks preferably in small bunker spaces in which stowing and trimming coal is always so difficult; all coaling stations should include crude oil tanks and pumps. Crude oil does not endanger coal piles, because the tanks can be isolated, and crude oil in bulk is more difficult to ignite than coal, and with specially fitted pipes, the oil can be used to rapidly destroy coal piles when this is necessary to prevent them falling into the enemy's hands. It is more difficult to destroy coal quickly than is ordinarily supposed, and special arrangements to this end should receive due consideration.

COLLIERS.

The defect of the merchant type of collier is its slow speed. This delays the squadron using them, and makes convoying necessary to prevent their capture or destruction by an enemy. On the other hand, the cost of high speed is enormous.

In the newer types of men-of-war, with recessed ports, and guns which dismount and house inboard, the taking of coal from a collier alongside is not a difficult matter even in a moderate sea, using cotton bale or other fenders, but our older ships with sponsons have always made it a hazardous and tedious process. The Brooklyn, with her tumble home sides, has always fared better than most other ships in heavy weather coaling alongside, and this emphasizes the desirability of tumble home sides for colliers. This means expensive and unusual construction, but what is known as the "turret" type of merchant steamer is the best collier in the market. The sides curve in from the load water-line, and the superstructure is practically a rectangular box set on a turtle back hull. There is a line of these steamers known as the "Branch Line" (Olive Branch, Oak Branch, etc.), which have made fine records in coaling foreign men-of-war, and would, if

purchased and given more powerful engines and boilers, serve admirably for accompanying squadrons as improvised colliers.

From the service papers it appears that the features of the two specially designed colliers are: Length, 450 feet; beam, 60 feet; draft, 26 feet at a loaded displacement of 12,500 tons. They are each to carry 7500 tons of coal, including bunker supply, and will have 16 knot maximum speed. As further legislation is necessary before these colliers can be constructed, it is not too late to suggest that the plans be amended to that of the "turret" type, and that consideration be given to tank construction for crude oil as an auxiliary supply.

Towing colliers at sea and coaling by conveyors has been demonstrated as practicable, but the slow rate of coaling is the principal disadvantage. The "turret" type is as well adapted to this as the ordinary merchant type.

While specially designed fast colliers to accompany fleets answer all the purposes of coaling stations in a general scheme of national defense, the real solution of the question of coal supply is in having a certain number of fast colliers, a certain number of slow colliers, and a chain of well-arranged coaling stations.

In deciding upon the number of specially designed colliers to accompany the fleet in time of war, the minimum ratio should be one collier for every four ships. Considering that there are two fleets, one in the Atlantic and one in the Pacific, the number of merchant colliers would probably be in the same ratio (one to four), but these can be augmented when war is imminent.

COALING STATIONS.

Admitting the necessity for a certain number of coaling stations, let us consider such details as storage bins or towers, cable cars and conveyors, automatic railways for coal handling, coal barges for rapid coaling, storage tanks for crude oil, adequate fire protection, the supply of fresh water in large quantities, fortifications, and the necessary garrison.

In coal storage and coal handling, the more recently constructed plants leave nothing to be desired in modern appliances. The different types of ships require different methods of delivering coal, but the mechanical handling is as rapid as any fleet can take it. Coal barges are needed to supplement even the most efficient coal-handling plants because some ships need barges on the off

side, and ships in the stream require barges on both sides, where the dock space is limited and there are an unusual number of ships coaling at once. Stations must be prepared for numerous contingencies. So far about 110 coal barges have been built and distributed to the various stations. Some of them have flat tops and are designed for smooth water, while others are deep steel barges for towing at sea or for use in a sea way.

The question of storage tanks for crude oil and adequate fire protection have been considered.

In furnishing ships with fresh water at all coaling stations it is evident that every gallon taken from shore is that much coal saved since the only means the ship has of supplying herself is through evaporating and distilling. The Bureau of Equipment now has over a dozen water barges distributed around the various stations, and an excellent type has been perfected through the co-operation of the Bureaus of Equipment and Construction, so that, where ships cannot take water at a dock, the barges can deliver water in the stream.

As to fortifications, so much depends upon local conditions that the only criterion is that each station should be capable of defending itself without the aid of a fleet, or be prepared to destroy the storage plant when seriously threatened by an enemy.

As to the question of who should garrison our coaling stations one must tread softly. Certainly the army should not. This is not saying that the sea coast artillery should not, but the sea coast artillery should now be and should have been all these years under the navy. The present marine corps and the sea coast artillery should be amalgamated as a distinct corps known as the marine artillery, and they should man the sea coast defenses and go to sea on our ships as marine guards. It is true that the marine corps is older than the navy, but it exists because of the navy and its traditions are those of a branch of the naval service. The sea coast artillery bears no relation to the army other than that a knowledge of ballistics is common to both, but as the navy is strictly a sea artillery, its training is in every way parallel to that of the sea coast artillery, only there is the distinction between firing from a fixed platform at known ranges and from a moving platform at only approximately known ones. Certainly no training of an artilleryman can compare with that he can get aboard of a man-of-war. It is wasteful and illogical to have two sources of

supply where sea coast and naval guns should be the same and their ammunition interchangeable. Submarine mine defenses, submarine boats, and torpedo boats should all be under the marine artillery. They are adjuncts of harbor defense, but should be operated in connection with the navy, and by people familiar with going to sea. These ideas are not popular with the auxiliary departments of the different arms of the national defense as now organized, but the infantry and cavalry can find little reason for the Army Appropriation Bill being annually saddled with the expenses of the maintenance of the sea coast artillery, when all they see of them is an occasional light battery, which really bears no relation to sea coast artillery, or an occasional artilleryman on detached service. On the other hand, the sea coast defense and harbor defense are intimately connected. It is the function of the fleet to be the first line of defense. When a fleet falls back behind the harbor defenses, its crews should in the last resort serve as reserves in the fortifications. This is co-operation carried to its logical conclusion. Recent history is full of illustrations of the aid given to sea coast defense by the crews and batteries of ships forced to seek shelter behind them.

Marines are at present artillerymen and soldiers; artillerymen on board ship, and soldiers on shore. That the sea coast artillery's function is naval is shown by the fact that their principal experience is gained in conjunction with the navy in maneuvers. Of course, the army should have siege and field guns and all of the paraphernalia of fortified defenses, but these bear no direct relation to sea coast artillery. This does not imply that the army is not needed in harbor defense, but its function is the landward defenses. The fortifications facing the sea and bordering on the channel leading from the sea, with the mine fields, submarines, and torpedo boats, should be manned by those who have had naval training, and who are controlled by the same department as that which governs the fleet. Considering only the national defense and leaving out the personal prejudices and inherited traditions, there is no logical reason why we should maintain the present flabby, flimsy and gauzy arrangement whereby the army, navy and marine corps, and the various branches of each, are constantly duplicating the other's work and encroaching on the functions one of the other. The humiliations and national disaster which await upon too close an adherence to traditions, however stupid,

are the inevitable result of the failure to keep the military machinery up to date. Radical steps are needed. To man the defenses of coaling stations with sea coast artillery under the army is illogical. The sea coast artillery has suffered nothing but starvation under the War Department. Its functions and its rewards are with successful co-operation with the navy.

COALING STATIONS ON FOREIGN SOIL.

The chief of the Bureau of Equipment in the annual report for 1903 says: "The establishment of the United States coal depots for naval use in foreign waters, owing to diplomatic consideration, is not discussed in this report." This voices the difficulty of others. A view of the accompanying chart of the coaling stations of Great Britain and the United States will show the contrast in our policies. Coaling concessions at Chiriqui Lagoon and the Galapagos Islands in connection with the Panama Canal are very desirable, and the realization is well within the limits of diplomacy. We have failed to purchase St. Thomas, but with Culebra Island only a few miles distant, the Danish Islands are not liable to be of much use to anyone else. The most we have to fear is the concession of coaling stations in Hayti, San Domingo, Venezuela, or the U. S. of Colombia to other powers, and if it happens, we will probably need all the coaling stations we have.

We should lose no time in establishing strongly fortified coaling stations and bases in the Pacific. Our future lies in the control of the Caribbean Sea and the North Pacific Ocean.

DUTCH HARBOR
SITKA
KISKA
ESQUIMAULT
QUEBEC
HALIFAX
UNITED STATES
Ships can take Coal at 38 places in the United States
BERMUDA
HONGKONG
HONOLULU
WEI-HAI-WEI
GUAM
MANILA
CAVITE
LABUAN
SANDAKAN
SARAWAK
SINGAPORE
FANNING I.
PORT ROYAL
PORT CASTRIES
BRIDGETOWN
PORT OF SPAIN
GEORGETOWN
SAN JUAN
BAHIA HONDA
GUANTANAMO
THURSDAY I.
TUTUILA (PAGO PAGO)
SUVA
CAIRNS
TOWNSVILLE
ROCKHAMPTON
BRISBANE
NEWCASTLE
SYDNEY
PORT KEMBLA
MELBOURNE
ADELAIDE
ALBANY
FREMANTLE
HOBART
WESTPORT
GREYMOUTH
WELLINGTON
LYTTLETON
NAPIER
AUCKLAND
INVERCARGILL
DUNEDIN
COQUIMBO
PORT STANLEY
AUSTRALIA
BRASIL
ANTARCTIC CONTINENT

GREENLAND
RUSSIAN EMPIRE
Ships can take Coal at 50 places in the United Kingdom
NORTH ATLANTIC OCEAN
CHINESE EMPIRE
GIBRALTAR
VALETTA (MALTA)
ALEXANDRIA
P. SAID
SUEZ
PERSIA
BUSHIRE
KARACHI
MASKAT
BRITISH INDIA
CALCUTTA
BOMBAY
RANGOON
MADRAS
PORT BLAIR
TRINCOMALI
COLOMBO
PORT DE GALLE
ADEN
PERIM I.
ST. VINCENT
BARBADOES
BRIDGETOWN
PORT OF SPAIN
GEORGETOWN
FREETOWN
LAGOS
ELMINA
SOUDAN
MAHE
ZANZIBAR
ASCENSION I.
ST. PAUL DE LOANDA
BRAZIL
JAMESTOWN
INDIAN OCEAN
PORT LOUIS
SOUTH ATLANTIC OCEAN
DURBAN (PORT NATAL)
CAPE TOWN
SIMONSTOWN
PORT STANLEY
COALING STATIONS OF GREAT BRITAIN AND THE UNITED STATES.
GREAT BRITAIN.
UNITED STATES.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

SOME HYGIENIC PRECAUTIONS TO BE OBSERVED IN TRAINING.*

By Surgeon Henry G. Beyer, U. S. N.

In thinking over the matter of what subjects to choose for my lectures at the war college this year, the conviction gradually took possession of me that the urgency of the hour demanded that something should be said on the *training* and the *care* of the men in our service from the *hygienic point of view.* I felt confident that every one of you, with years of practical experience behind him and with the amount of thought already given to the problem, would be prepared to admit that it was impossible to study the question of *training* from too many points of view and that additional light from almost any direction might, therefore, be received with interest. From the number of able treatises that have appeared from time to time in the columns of the Naval Institute, the subject appears to be a large and comprehensive one and I must state at the outset that my remarks will be limited to the *hygienic precautions* that are to be observed in the care and training of our men. Even then, my time will only permit me to touch upon the *general principles* of my theme, from which, however, it will be easy for you to deduce the details as they may apply to special cases.

By way of introduction, I will merely state that in discussing this very important subject I will leave aside, as much as possible, all sentimental and emotional aspects of it and try to consider the man under training merely from an economic point of view, as a living machine to be educated for service in the Navy of the

* Read at the Naval War College, July 21, 1904.

United States and as an intelligent tool in the hands of his commanding officer.

The ultimate object of all training we will admit to be the development to perfection of all those inherited and potential qualities in a man which will make out of him the best and most useful man possible.

As a *living* machine, man differs, in the first place, from a machine made by human hands in that it can be trained and improved by proper use and in that it contains within itself the germs of its own perfectibility. It must always be kept in mind by those who have the care of men in their keeping that the living machinery of man is subject to certain immutable laws, which must remain inviolate and the combined influence of which upon his development is absolute and inalterable. These laws must, therefore, be known, duly observed and properly administered in order that his training by educational processes may result in the highest degree of efficiency attainable,—which his inherited faculties will admit of.

When considered in this light, it will at once be seen how great is the responsibility that rests with the trainers and caretakers of the men in the service and how essential it is that they should know the laws, the observance of which is now regarded as fundamental and conditional to success of any kind.

Broadly considered, the Navy in all its various branches is a great school in which the attendance is compulsory, work obligatory, discipline strict and the end and object serious and well defined. Hence, all the principles of school hygiene apply also to the naval service. A very, if not the most, essential difference between an ordinary school and the naval service is that, in the former, the education may be spontaneous, more or less unhampered and free, under the merely *guiding* influence of the teacher, while in the latter, the education must proceed along certain absolutely defined lines and in accordance with the strictest regulations emanating from lawful authority, and which leave the pupils no choice or selection of their subjects. Hence, also, the far greater responsibility of the heads of such schools and the necessity that the training and education in them be done on the best principles which the sciences of the day have evolved.

The key to our problem and the point I am aiming at will become clear to you by the following brief consideration of a

simple physiological law which applies to all living things, including man, and with which all our educational efforts must agree, whether they be addressed to the mind or the physique of the man. This law states, that the *exercise of the normal function* of *any organ* or *combination* of *organs* or *tissues will exert a favorable influence upon the structure, growth and working capacity of that organ or tissue as long as the burden of the work, implied in the exercise, is kept within the physiological range of the capacity of the organ involved.* We know that absolute inactivity of any organ or tissue of the body is followed by a process of degeneration and, that, on the other hand, activity carried beyond the normal range of the endurance of an organ, is followed by fatigue, exhaustion and ultimate paralysis. Between these two extreme limiting points lies the normal range of our endurance and somewhere within this normal range we will find the optimum point of activity for work, which is the point at which work exerts the most favorable reflex influence upon the normal growth and development of the organ concerned.

The object of all objects in education and training being the *permanent increase in the capacity and endurance for work,* it follows that the highest results can only be obtained when we observe this point and try to keep the amounts of our instruction and training well within the range of the endurance of the individual as well as within that of the average, in handling a large number of men as we do in drills. If more is demanded, the educational result will be failure; if less is exacted, we do not make the best of our opportunities.

So far, then, as concerns the capacity for work, we know by experience that it can be increased, if the proper principles are observed. The nearer we come to observe these, the better must be our results; for there are degrees even of perfection.

The question will, by this time, probably have arisen in the minds of those of you who have followed me in my argument: How can we tell whether we exact too much or too little from the men under training? Two things must be relied upon for giving you that information, namely: (1) the physique of your men, as determined by the scale and the tape measure, and (2) the quality and character of the work done by them as determined by their records. In other words, it is by the *product of your work* that you must judge the method. Everything else being equal, the

difference in the records between two ships, for instance, during an important maneuver, must be taken as an index to the success and the manner with which the educational work on the two ships has been performed. The same difference must decide which one of two ships will sink the other in the event of a fight between them. The result will be the same, whether we overtrain our men by exacting more than the law allows or whether we undertrain them by not exacting enough; in other words by failing to make the best out of the men under training which the above law allows. Whether the records of the performances of the work done by the men can be so kept as to form a guide that will be consulted at more frequent intervals than is now the case, I am not prepared to say. A method by which their physical status could be ascertained and compared with past records could be more easily suggested.

These are in brief the bold outlines of the skeleton of this subject. Into the details of it we have no time to enter, nor would it, in my opinion, be good judgment on my part to burden you here with the minute details of it. It was my purpose, as mentioned in the beginning, to impress you with the broad principles of it, because the details can be deduced from them when thoroughly mastered, later, and when you will have the necessary leisure to consider them on board the ship you will command and where you will always have one or more medical officers to consult.

There is, however, one thing upon the nature and causes of which it is necessary for me to dwell a little longer and which the commander of a large body of men should be able to recognize when it occurs among his men. I refer to the subject of *fatigue*. Fatigue is the danger signal and precedes the stage of exhaustion beyond which, as you now know, any further educational effort is futile and ceases to be attended with the desired result.

(1) The nature of this condition can perhaps best be shown by a brief description of a simple instrument, and the experiment that is made with this instrument in physiological laboratories, to ascertain what is known as the fatigue curve of a person. The instrument is called the ergograph. This instrument is very simple in construction and consists of a weight to which is attached a strong cord. The cord is passed over a pulley and the loose end is attached to the end of the finger, generally the middle finger of the hand which rests with its back on a support in the extended

state. A little above the weight a pencil is attached to the cord so that it can be made to write its excursions on the smoked paper of a drum, revolving at a certain rate, whenever the finger is flexed and raises the weight. When the experiment begins, the finger starts to raise the weight at a certain rate and continues to be flexed and extended as long as it has the power to do so. The resulting tracing is known as the fatigue curve of the man. The finger, that is the muscles and nervous apparatus engaged in doing this work, is in a state of fatigue when it is unable to raise the weight any longer. Fatigue is that condition which is due to the accumulation of the products of wear and tear in the tissues that do the work. Experiments have shown that this condition is produced both in muscle and in the central nervous system whenever the work they are required to do is excessive. Fatigue is not yet exhaustion, and although the former condition precedes the latter, the cause of exhaustion is a lack of material which is necessary to make up the loss in energy expended, while the cause of fatigue is the accumulation of the products of wear and tear in the tissues.

The exercise of an organ stimulates the destructive phase of an organ, rest starts the assimilative phase. To keep any organ in the state of equilibrium, the amount of damage done to the tissues must be repaired, and to this end they must get an interval of rest sufficiently great to accomplish it. In order to cause the organs engaged to grow and develop, the object we are trying to attain, the rest period must be greater than the working period.

You will see then that in fatigue it is more especially the disassimilative phase that suffers. But, when this state recurs too often, we find that the assimilative phase begins to weaken, and when this gives out a more permanent state of exhaustion supervenes which is not so easily recovered from as is the simple state of fatigue. Hence the great importance of recognizing the state of fatigue in time to avoid the greater danger of overtraining which is exhaustion and which practically paralyzes all further educational efforts.

The recognition of the stage of fatigue is of such paramount importance as to justify me in analyzing it a little further with you. If we, for instance, examine some of the curves obtained by the ergograph of Mosso, we find them all to be made up of

three essential elements which can be expressed by the following simple fraction, $\frac{P}{R\,r}$, where P represents the available power of the neuro-muscular apparatus, R stands for the resistance and r for the rate with which the resistance is overcome or the weight lifted. The fatigue curve, then, may be modified by varying either the resistance or the rate, or both together, as we can see in the tracings produced. By reducing the rate, we can even prolong the curve almost indefinitely. The reasons for this must now be clear to you: it is simply due to the recreative rest period being prolonged. The products of wear and tear are given a chance to drain out of the tissues. This simple fraction tells you not only the nature and composition of all efforts, but it gives you besides the key for modifying the results to suit any requirements which you may meet with in practical life.

So far I have abstained from giving a single instance from practical life of how fatigue is produced. I have done so purposely for the reason that the greatest variety of conditions in practical life will lead to the condition known as fatigue, and because I wished to avoid the impression on your minds which would lead you to connect it with a particular sequence of events. Instead of attaching any special importance to any particular combination of circumstances as being productive of fatigue, it will be more advantageous to our purpose to remember the general law that *continued effort in any one direction without change or relief* will inevitably be followed sooner or later by fatigue and exhaustion. The living machine will work its own destruction, without the required and necessary period of rest and recreation. And this is the inevitable consequence of any continued effort, whether it be work visible or invisible, whether it be lifting heavy burdens or looking at a printed page. As long as there is an *effort* involved in the process, whether it be hauling on a rope or whether it be sitting down and waiting for something with hands folded, as long as it is enforced, it is also liable to lead on to a state of fatigue and exhaustion. Utter monotony, which would seem at first sight a safeguard and probably often is, because it transfers conscious effort and responsibility from the higher nerve centers to the lower automatic ones, is in reality more trying and wearing than forms of labor of a higher and more strenuous order. According to my experience and observation

the fatigue and exhaustion noted among the men on board ship, in fact, do least often come from the amount of work the men are required to do whether it be mental or physical. They are most frequently the direct result of causes operating against the normal development of a good will and spirit on the part of the men, as for instance when they are forced to do something, no matter what that may be, in spite of want of interest, disgust and ennui.

These being the simple facts, how can this state be recognized in a large body of men? It would, of course, be impossible to ascertain it by taking the fatigue curve of every man on board of a large ship, even if it was necessary, which it is not. Whenever the time comes when your men show a spirit of increasing discontent, when the records begin to show an ever increasing number of infractions against the discipline of the ship, when the prison cells are full and overflowing and the admissions to the sick list begin to show an increase in number, without an appreciable cause, when murmurs are heard and discontent is openly expressed about the insufficiency of liberty and the desertions begin to increase, when individual punishments are resisted and interpreted more as being individual injuries than as the result of the logical sequence of offenses against the regulations, then you may be sure that something is wrong somewhere in the "king's household" and that both your officers as well as your men are dangerously near the condition expressive of fatigue from some cause or other.

Whenever this state of things supervenes, you may be very sure that you have lost or are beginning to lose control over the best part that is in your men; indeed the men themselves are beginning to lose control over the best part of their own actions, even if they still submit to the routine discipline, just as truly as a man loses control of his own normal temperature when he becomes infected with a disease-producing germ. Whenever, as I said, this condition becomes an undeniable fact and is brought to the attention of the commanding officer, it will require him, if he knows his interest, to cause a thorough investigation into the methods of the work done and ascertain the remedies most likely to counteract the evil.

It is the spirit of the ship's company for which the commanding officer must cultivate a keen sense of appreciation. So far as the educational results are concerned, it would indeed be better to stop all drills and suspend for a time the entire routine of the

ship and send everybody out of the ship that can be spared, for all the good that you would produce by continuing the methods that have brought on this state of affairs. Before you have succeeded in eliminating every just cause of the discontent that has taken possession of your men and, before you will have in a measure restored the good spirit of them, you will not be able to make any headway so far as the results of your educational efforts are concerned, for you have, for the time being at least, lost control of the best parts of the human machine, namely, its good will or spirit.

If, under such circumstances, it was possible to take the fatigue curve of every man on board a discontented ship and these curves could be compared with the curves taken from the same men under more favorable conditions, they would show a most astonishing loss in the range of endurance. Expressed in different terms it would be shown that their normal range of endurance has decreased, or the extreme limiting points of it have moved to a position nearer each other. In other words such comparison would show that the very opposite result had been obtained from that which was expected; the men being the same, it could only follow that your methods must be wrong and consequently it would be these that would require your first attention.

And this brings us face to face with another side of our subject. We have now been made painfully aware of the fact that the normal or physiological range of the endurance of any part of our anatomy is liable to be made narrower as well as wider, in strict accordance with the character of the methods employed.

In this particular instance, it was shown that the lack of the proper spirit on the part of those to be educated and trained proved to be the cause of the narrowing of the normal range of endurance throughout all parts of the human machine to which ever our efforts may be addressed. It follows, therefore, that the proper spirit, and its development and maintenance, is of far more fundamental importance and of greater general significance than the development of any other single human trait or faculty within our educational reach. This should, consequently, be made the object of our first aim and one that should be kept constantly in mind and never for one moment lost sight of, no matter what other special aim it may be that is ultimately to be reached.

Fortunately the training of this spirit is not a matter of chance

but as much the result of carefully considered educational methods as is the development of any other human trait or faculty. This assertion needs proof of the strongest kind in order that it shall carry absolute conviction.

Since, to convince you of this fact, forms the climax of my entire argument and the chief object of this paper, I will for the first time be compelled to leave theoretical ground and step out into the arena of practical life. This spirit upon which so much stress was laid in the foregoing, call it esprit de corps, or whatever you may, is, at the bottom, nothing but *interest*, personal, individual interest in the things you do, accompanied by a certain pride in how the things are done, summed up in self respect. Interest, then, being at the bottom of it all, how is this to be aroused? Interest in any art, science, profession or trade is practically impossible without previously acquired knowledge. Interest in anything whatsoever can only be begotten in previously acquired knowledge of the thing. The first, most important and fundamental step we must take with a view of acquiring an interest in the work before us is to acquire a knowledge of the "how" it is to be done. It stands to reason, then, that whether this interest is finally aroused or not, can only depend upon the method of instruction that was employed, and, that the amount of interest thus aroused must be in direct proportion to the amount of knowledge acquired by the individual, of the subject concerned. The beginning will have been made and the foundation laid with the acquisition of a certain amount of knowledge.

The method employed to bring about the expected result must be in accord with human nature. Human nature demands that the burden of the work we are required to do be adapted to the working capacity of the individual, if the expected result is to be increased capacity for the same kind of work. In the beginning of all things, large amounts of work and long periods of work must be avoided, lest our object be failure at its inception. Short periods of real and accurate, slow work, with frequent pauses, to be lengthened gradually, must be our beginning. Why is this so? Referring to our range of endurance it will be seen that we can only by such methods keep nearest the optimum point of our working capacity, and we already know that by doing so it may confidently be expected that a daily increase in our knowledge, and consequently in *interest*, will be the certain result of our efforts.

Just as the normal range of the digestive powers of our stomachs can only be very gradually increased in the newly born by a careful gradation of our demands upon the digestive functions, and just as we would produce certain ruin by attempting to feed an infant with a complete meal for an adult, instead of the easily digested mother's milk, just so would our results be equally attended by failure by the application of similar methods with a mental pabulum which is new to the individual. The best results, in other words, are possible only when we keep our burden well within the range of the working capacity of the learner, as near as we can to the optimum point, but never past the point of fatigue. The nearer our methods are calculated to attain this end, the surer we may be of a daily increase in knowledge, interest and power on the part of our pupils.

All training and education should, accordingly, be begun by slow and easy steps, and aim much more at qualitative thoroughness than at quantitative results until the novice has mastered all the little details and the technique of his work and—what is of the greatest importance—has been made himself conscious of the fact that he has gained and progressed. Nothing indeed is so well and so directly calculated to arouse in him the spirit we are aiming to develop as the self-consciousness on the part of the learner that he *has* progressed and *is* daily progressing in overcoming the difficulties of the task set before him. This, as you will now understand, can only be accomplished when the burden of the work is kept constantly within the limits of the capacity of the individual.

Finally, when the learner gives absolute and certain proof of the fact that he has by slow and easy steps mastered all the details of the work before him and can do it without fatigue, we may begin to increase the rate at which the work is done, but according to the same principle and *never* at the expense of sacrificing either accuracy or thoroughness. It is only by the most careful attention to these details in the methods of training that the highest results of perfection and the largest number of men can ever be reached.

All training, accordingly, to be attended by the highest results and by the development of that interest and that spirit for the work which we have found is so essential, must be divided into two distinct stages: First, we must aim at teaching the

beginner to overcome the real difficulties of each part of the technique—that is the burden or the weight of it—by slow and easy steps and with great patience and, second, we must drill him with a view to increasing the speed with which the work is to be done (the rate with which our weight is lifted), until both accuracy and thoroughness combined with rapidity will have reached the highest degree of attainable perfection consistent with human faculties.

I will here mention only incidentally that this conception of the subject of education and training would render absolutely wrong in principle the proposition, which I have read somewhere was made, namely, of mixing untrained landsmen with thoroughly trained seamen for the purpose of training the former. The results of such an association might be the development of a few exceptionally gifted boys, but the great majority of them would certainly be ruined. We must aim at least at the average, if not at the great majority of our enlisted force.

Referring once more to our classical fatigue curve and to our fraction, let us review what we have done so far and how it was done. We have accomplished our results by first decreasing the weight, dividing it into small sections, but have insisted upon the lifting of each fraction with accuracy and thoroughness, thus exercising the entire circuit of the anatomy engaged in the work. We have gradually increased the burden, without sacrificing thoroughness until the full amount of the burden was reached and overcome with ease and, at last, we have increased the rate in addition, until the highest perfection attainable in both was accomplished. We have, in addition, at the same time and by the same method, developed an unconquerable pride in our man, based upon his personal interest in the work accomplished and upon his own consciousness that he not only knows his duty but that he can also do it as well as any man living. The result is an accomplished artist with an undaunted spirit.

Suppose now that we had overburdened this same man by demanding more of him in the beginning than was within the normal capacity of him or any other man, by training according to the formula $\frac{P}{R_1 R_2 R_{3n}}$. It can be easily seen that, with the same amount of available power or capacity, dividing it into 20 or 30 parts by attempting to teach a man as many different things at one

time, no useful results could ever be expected and none have been recorded. The man as well as the instructor will see the utter hopelessness of the expected result and both will become dissatisfied and discouraged long before any results are reached. In other words, their spirits will become depressed. Here, for instance, is an example, illustrative of the indubitable fact that the spirit of your men is directly connected with and traceable to the methods of instruction you employ. This natural sequence of events is moreover based upon the natural law that the burden must be adapted to the capacity, if the latter is to be trained to higher power. The consequence of such methods of training indeed would be utter failure, and for reasons that are as unalterable as human nature itself. The best result than can be expected by such a method of training is that one out of a hundred men, at the end of twenty or more years of such training, would turn out that "good all around man," the handy man, the jack of all trades and master of none, perhaps the best man to win your battles in the old days but of very little use in a modern sea fight.

An example and exponent of the results of methods of training more in keeping with natural laws and more in harmony with the present and future needs we have in the modern and recently trained gun pointer. With his eyes on the target and his hand on the gun gear, trained by gradual and easy steps up to his work, allowed to concentrate and direct all his available power upon one thing, this expert could never have been accomplished if his individual energy had been split up between fifty different drills; neither would he have developed that proud spirit had he not been made to feel that he had accomplished a great thing and was constantly encouraged to accomplish still greater ones in the future, by methods of education in perfect harmony with the eternal laws of human nature. He is one of the exponents of the class of specialists needed in every part of the ship, each one developed to the highest degree of perfection in his own duty, and working in concert with every other man, in order to win in a modern sea fight.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

SOME REMARKS ON THE ADMINISTRATION OF JUSTICE IN THE NAVY.

By Lieut.-Comdr. John Hood, U. S. N.

The following remarks are offered for publication in the Institute with a view of eliciting an expression of opinion from the service at large, on certain points connected with the use and abuse of courts-martial, the administration of discipline in the service and the maintenance of a high standard of service honor.

In connection with the laws and customs of the service bearing on these points there has always appeared to me to be an erroneous sentiment in very general existence among the officers of the Navy; and, so long as this sentiment is accepted as the true expression of the opinion and feeling of the service, there will be no hope of change.

But if mature thought on the part of the officers of the Navy generally should convince them, as it has me and, I have no doubt, many other officers as well, that the sentiment *is* erroneous, then a general service opinion might be brought to bear that might lead to a change in both the laws and customs of the service, much to the betterment of discipline and the maintenance of a higher sense of duty and greater esprit de corps.

The sentiment I speak of is the universal dread of the officers of the Navy to being brought to trial before a court-martial, a dread which seems to me to be largely due to a misconception of what the proper functions of a Naval or Military Court should be. Such courts are not criminal courts in the sense of the common and statutory law; they are courts of honor and equity as well as of justice, to which the honor and integrity of the service, and the officers thereof, may, or should be, left as safely as the administra-

tion of justice and the infliction of punishment. There is no disgrace in the fact of being brought to trial before such a court. The disgrace consists in the *conviction* of the party tried of the culpable neglect of duty, inexcusable carelessness in the performance of duty, inefficiency, drunkenness, or whatever the charge may have been. An honorable acquittal should, and would, relieve the party concerned from all suspicion of blame, a suspicion that will inevitably attach, under present conditions, to any officer in the service connected with any serious accident, however innocent or praiseworthy his action may have been. The innocent have nothing to fear and much to gain by trial, the guilty should be tried.

In the state of sentiment of the service to-day, one frequently hears the remark that "courts-martial are organized to convict"; and, as the laws and customs of the Navy are carried out at the present time, there is unfortunately a fundamental truth in this saying, hardly contemplated by the founders of such courts. This would seem to be due, partly, to the fact that courts of inquiry largely perform functions that in many cases would be far better performed, both in the interest of the service and of the individuals concerned, by courts-martial; and partly to the very existence of the sentiment spoken of, which causes those in authority to hesitate to bring offenders to trial by court-martial, until the offenses have become so flagrant that any other result than conviction is impossible. These two causes, in both of which are considerable elements of moral weakness, to use no stronger term, tend greatly to lower the dignity and respect in which courts-martial and their judgments should be held; and have, moreover, caused grave scandals in the past, left honorable names under undeserved stigma, and assisted many culpable offenders to escape just punishment.

The mere existence of the feeling that causes officers of the Navy to fight to the end against trial by court-martial, even in questions that would seem to me to directly and vitally affect their personal and professional honor and reputation, where acquittal by a competent court is the only vindication, is sufficient proof in itself that something is radically wrong.

That courts of inquiry, before which there is no accused and no defense, cannot vindicate character in the eyes of the service is self-evident, and has been often proved. That a stigma now re-

mains in the minds of many on the name of any officer who has been tried, even when acquitted, is too well known to be questioned, and proves clearly that the system, as administered, has undermined the feeling of trust and confidence in the justice and integrity of the various forms of naval courts which is absolutely necessary for the maintenance of military discipline and efficiency.

This condition will continue so long as the service at large looks on a trial per se as a disgrace, refuses to attach the disgrace to those only who are proved guilty, and endeavors to make impersonal courts of inquiry do the duty of courts-martial where the honor and professional reputation of an officer is at stake, a proceeding, in the case of any great disaster or accident, that at best can only leave in the mind of the service the impression of a case of "not proven."

The honor of the service and of the individual officer should be as sensitive as the reputation of a woman, and no shadow of suspicion should rest upon either. Where there is a question, it should be proved beyond the cavil of a doubt, and the person declared innocent or guilty. In every case of unusual failure, great accident or disaster, there is always a doubt; and it is the right of the service and of the officers concerned to have this doubt cleared away.

Responsibility exists always, or naval discipline and efficiency ends. The commander of a fleet, squadron or vessel can no more lay aside his responsibility than he can his commission; and the responsibility for his command is with him always.

In cases of great achievement he alone is held responsible and reaps the reward; and through him only is reward and praise distributed to his subordinates.

In cases of failure, grave accident, or disaster, he is likewise always *primarily* responsible, though the responsibility may not be culpable; and the facts may even prove him to have been highly praiseworthy. It is due to him that these facts should be brought out and a clear and definite sentence pronounced by a competent court when there is no culpability; it is due the service at large when there is.

If these ideas are based on sound military principle, as they appear to me to be, I would like to condense them in a few simple questions, inviting answers and discussion in the Institute, that service opinion may be brought to bear to correct evils, if they exist:

1. Why should disgrace attach to the mere fact of being tried by court-martial?

2. Does not the disgrace consist entirely and solely in guilt and the conviction thereof?

3. Are there not often cases arising from accident, avoidable or otherwise, in which the professional honor and reputation of one or more officers are attainted in the minds of their fellows, without ever having the question clearly settled by pronounced judgment?

4. Is it consonant with good military principles, and is it just to the innocent, to leave such cases to the indeterminate settlement of courts of inquiry, by which no final decision can be pronounced?

5. Cannot the existent dread in the Navy of trial by court-martial be overcome, and a sentiment cultivated of looking upon such courts as vindicators of innocence as much as punishers of guilt?

6. Is it the sense of the service, or conducive to military efficiency, that the question of the innocence or guilt of officers who are prima facie responsible for failures, accidents and disasters should be clearly and definitely settled for all time by a competent court? and does the naval system of courts as now constituted accomplish that end?

7. If they do not, and it must be admitted that errors and inconsistencies are sufficiently frequent to raise the question, what is the duty of the service at large in regard to endeavoring to correct the evil?

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

FIRE CONTROL.

By Lieut. W. S. Turpin, U. S. N.

A great deal has been written of late concerning the training necessary to bring the efficiency of the Navy to the highest point. Most of these articles, however, have dealt solely with that part of the training which might be called elementary, and the writers have confined themselves almost entirely to the training of recruits and to the gunnery training.

It is the intention of this paper to carry this training a bit further and to discuss that necessary for the ship considered as a fighting unit.

The fighting efficiency of a ship consists of so many intricate and delicate problems that it would be madness to expect them to be even adequately mentioned in one paper, therefore only one branch of this efficiency will be considered.

That particular part, which it is proposed to discuss, is fully as important, if not more so, than any of the others. It is *fire control.*

For the purposes of this paper fire control may be defined as "the direction of the fire of the ship, by the officer or officers directly responsible, so that the guns, as a concerted whole, may be used to the greatest advantage; that is, hitting the enemy as often and as advantageously as possible."

The importance of fire control cannot be over estimated. An efficient system gives the captain of the ship, and, through him, the commander of a fleet, the power to use the armament of his ship to the best possible advantage.

It needs little or no argument to show the immense advantage a ship with a good fire control system would have over one without, other things, of course, being equal.

The great importance of fire control is perhaps best seen when the *ship as a whole, and not the individual gun,* is considered as the unit. If the guns of a ship cannot be controlled, and the fire of that ship used as a concerted whole, then the value of that ship, in the fleet, is, to say the least, very much reduced, if it is not almost entirely nil. On the other hand an efficient control removes all the elements of uncertainty as to the results of an action except that of the efficiency of the gun pointers. For the purposes of this paper it is assumed that the pointers are properly trained and, if they are furnished with the necessary information to enable them to set their sights correctly, they will hit.

The term fire control having been defined it remains to point out the elements necessary to establish an efficient system.

In any system we may adopt it must be remembered that, to obtain the best results, "the power of the direction of the fire must remain in the hands of the captain." He may delegate the active part of this work to some other officer, and the very nature of things will, in all probability, make this necessary, but the principle remains as hard and fast as ever, that he alone is responsible.

The conditions which must be fulfilled to obtain the full control necessary in action are:

1. A good system of communications.
2. Good observation of the fire.
3. An efficient system of finding the range.
4. Logical distribution of the duties among the different officers of the ships.

COMMUNICATIONS.

It needs no argument to make it plain that without communications no attempt can be made at fire control. Not only must there be communications but they must be efficient. The question that naturally presents itself is what constitutes efficient communications? Briefly, they must possess speed and reliability. By reliability we mean that there should be no possibility of the receiver of an order making any mistake as to its meaning. It might perhaps be argued that this is an ideal condition and perhaps it is, but we can examine the means at our disposal and approximate as closely as possible to its fulfillment.

What are these means? They are:

(a). Messengers.

(b). Bugle calls and sound signals.

(c). Voice tubes and telephones.

(d). Automatic indicators. (Electrical or mechanical.)

Of these, messengers are perhaps reliable but they are certainly not rapid, and, if they are used, it is very probable that at the very time that they are most needed, they are not at hand. They can therefore be eliminated from our main system of communications although they might be a most useful adjunct.

Bugle calls might be used for some particular cases but their use is very limited, and they possess the additional disadvantage of being very unreliable and especially so in the heat of an action, where the noise would probably drown the sound.

Voice tubes and telephones are useful in a way and should certainly be fitted for use in the secondary line of communication.

They possess the disadvantage, however, of not being reliable, as they are frequently out of order and the shock of firing is very liable to derange them at the most critical moment. They are also slow, and, as it is necessary to employ an exchange, orders cannot be directly communicated to the guns from the conning tower or central station. There is also no assurance that the orders transmitted have been understood.

The remaining means is the mechanical or electrical indicator.

Let us first see the capabilities of the mechanical indicator. It certainly possesses speed, for the command is registered on the receiver practically as soon as the transmitter is operated. The speed requirements are fulfilled and this type of instrument is quite reliable, but there is one insurmountable drawback, that is, that it is necessary to have a very large number of transmitters to supply an adequate number of receivers, for not more than three receivers can be attached to the same transmitter.

Having studied the capabilities of the mechanical indicator and found it wanting, there remains the electrical indicator. It most certainly possesses speed and it can be and is designed so that it is equally if not more reliable than the mechanical type.

On the whole the electrical instruments more nearly fulfill the conditions assumed, speed and reliability, than any other form of communication.

Before leaving the subject of communications the nature of the

orders that they are required to transmit should be analyzed. In order to do this the information required at the gun must be stated. This should be:

(a). Ranges.

(b). The target, or, in other words, the particular ship on which it is desired to concentrate the fire.

(c). The bearing of the target.

(d). The speed of the firing ship; also the speed relative to the target.

(e). The nature of the projectiles to be used.

(f). Commands necessary in battle such as "Commence and Cease firing."

(g). Instructions as to whether the fire should be rapid or slow.

(h). The portion of the target it is desired to attack.

It has been suggested, and with reason, that there should be a separate instrument to transmit each part of this varied and necessary information. The great advantage claimed is that there is always one place, and no other, to look for certain information and also that only one command appears at one instrument at a time. This is certainly a very great advantage, but is it not outweighed by the very great disadvantage of having so many to install and also by the increased possibility of their becoming deranged? It is quite possible to so combine the instruments that there should be only three instead of seven. One would show the range, another combines the commands used in battle with the instructions about the projectiles and the rate of fire desired, and the third is available for commands relative to speed and bearing of the target and also the designation of the target. It is very difficult to have an instrument that will designate in more than a general way the target to be used; hence it is perhaps better to leave off this last information and to use in its stead a telephone or voice tube, as with either of these very complete information can be given.

The proper location of the instruments must be considered. It is perfectly conceivable that the orders to be transmitted to the turret guns may differ entirely from those to be sent to the intermediate or secondary battery; hence it is necessary to have a transmitter for each of these different classes. It is also very desirable to be able to give orders to the starboard battery and at the

same time to cut out the port battery. This can be arranged very simply by having a switch which throws in any desired group of guns; it is much better, however, to have one transmitter for each side, starboard and port, and one for each group of turret guns. It is of course necessary to have a receiver of each type in each turret and at each isolated gun position, and it would be of great advantage to have one at each gun but this is not absolutely necessary except perhaps in the case of the range receiver. There must, however, be a set of receivers for each group of guns of the intermediate battery.

The receivers must be so fitted that at each change of orders attention is called to it by some means, such as the tap of a bell.

An objection might be raised to such an elaborate system of communication by saying that it would probably be put out of order very early in the action; that objection however, is not well founded, for, as will be shown later, the beginning of an action is the very time when an efficient control is most necessary, and, even if the system is in operation for a very limited time only, it is certainly worth the labor and money expended on it if it will assist, to no matter how small a degree, in establishing a supremacy of fire which is essential to the successful ending of any action.

The transmitters should of course be located in the conning tower, unless it is deemed advisable to have a separate station for this specific purpose. In some respects this latter may be advisable, but on the whole the conning tower is the best location, for there the captain is close at hand to give any orders that he may wish. If the separate station is adopted, then there must be an efficient line of communications from that station to the conning tower.

In the above outline of the system of communications no provision has been made for connecting the observation station with the central control. As will be seen later this is most important, provided the observer is stationed at some place other than the conning tower or control station. It is necessary therefore to have a line of communication through which the range, or else the fall of the shots, can be communicated to the fire control party. It is an open question whether it is better to communicate the fall of the shots or for the observer to set the range directly from his observations. Whichever method is used the necessity for the line of communications remains and it must be fitted. If the

ranges are to be communicated directly, then an automatic indicator must be used; if only the fall of the shots, then that instrument may be used but it should be supplemented by a telephone or voice pipe. The telephone or voice pipes must be perfect to be of any use.

OBSERVATION OF FIRE.

By observation of fire is meant the ability to see the point of impact of any particular shot.

The difficulties which surround the successful use of this very important adjunct to the fire control are most numerous. With only one gun firing it is a comparatively easy matter to see the fall of the shot; but even then it requires an immense amount of skill to apply the results of the observation, for at best we can only tell whether a shot is over or short and then only if the direction is correct. In action, where all the guns are firing, it is much more complicated, for we can rarely be sure of the gun from which any particular shot was fired, the fall of which we have seen. Again, in action we have not the benefit of knowing that a shot is over, for the target will hide its fall. Shots that are over and shots that hit will look the same unless we can actually see the shot hit, which is most improbable; therefore we have only short shots to guide us.

Granting that we have seen the fall of the shot, it is most difficult to estimate how much it is over or short, and the nearer the water the observer is the greater this difficulty. It is evident that the station of the observer should be as high as possible; it should also be so placed that the view is unobstructed. The top is the best place for this station. This position is necessarily very much exposed and taking this into consideration it is perhaps better for him to transmit the results of his observations to the central control station and there let the necessary changes of range be made. The destruction of this station will not then stop all transmission of the range and it can still be transmitted from the central control station. On the other hand, if the range is transmitted directly from the observer, the destruction of his station will at once make the fire unit the gun, which we have seen is not desirable.

The actual observation of the fall of the shot does not require any great amount of training but making the proper deductions

from these observations is not only most important but also most difficult; this cannot be acquired by study but must be learned from experience.

The best training for acquiring this necessary skill would of course be constant practice observing the fire of the guns of the ship. Considerations of cost alone prohibit the use of this method and this training can only be had at the regular target practices.

The next best thing seems to be the use of the sub-calibre tubes fitted in the big guns.

It is not expected that even the most expert observer can supply the changes of range necessary for the sight setters, the most that he can do is to supply the necessary data to find the rate of change and there must be some empirical rule fixed for the use of the sight setters, in other words he is more of a check on the methods in use for keeping the range after it has once been found.

The difficulty of observing, or rather making the value of the observation useful, increases with the range. The accuracy of the observations also depend largely on the height of the observer. This is perhaps best shown by a few figures.

Let us suppose the observer to be one hundred feet above the water line (far higher than most tops), and the target to be ten feet high (far lower than the actual target will be), then a shot which is seen to strike in line with the top of the target will, at 1000 yards, be 111 yards over; at 2000 yards, 222 yards over; and so on up to 6000 yards when it will be 666 yards over.

A very small error in judging whether the shot strikes exactly in line with the top of the target will increase this distance very materially.

It is plain that we must have very careful training to properly interpret what we see, for the angle is so small that shots that are in reality very wild seem to us to be quite good.

On the whole this method is not entirely satisfactory but it seems to offer the greatest possibilities of any that we have. There is a slight modification which may be of value and that is to follow the flight of the projectile in the air. This is quite feasible at short ranges and with only one gun firing, but it is questionable if it can be used in action.

RANGE FINDING.

A most important part of fire control is that of finding the range, in fact without some method of doing this no central control, at least, is possible. In addition to its importance it is perhaps the most difficult problem with which the naval profession has to deal.

Before discussing the question of how best to solve this problem some of the features of it must be stated. What are the ranges that we will have to determine; in other words what are the probable ranges that will be used in action?

The inner limit is easily defined, it is the effective range of the torpedo; it would be simple madness to place a ship so near the enemy that any advantage of gun fire would be nullified by a well directed torpedo. This range may be considered as fifteen hundred yards.

The outer limit is not so definitely defined, but from the knowledge that we have of the trajectories of our guns, we can form some estimate of what it is likely to be.

The danger space at the various ranges is perhaps our best guide in this respect. The following table gives it to us very closely:

	6″ Gun.	13″ Gun.
1000 yards	982 yards	All.
2000 "	414 "	466 yards.
3000 "	228 "	285 "
4000 "	138 "	259 "
5000 "	90 "	144 "
6000 "	62 "	110 "
7000 "	45 "	86 "

The target in this case being thirty feet high, which is somewhat higher than most of the targets that we will have to shoot at. The guns are the service guns of 40 calibres length for the 6″ and 35 calibres for the 13″.

An inspection of this table shows us that as the range increases so must the accuracy with which it is determined.

There are two possible methods that are available for range finding:

(1) By mechanical means.

(2) By the observation of the fire and the use of the armament itself.

The requirements for mechanical range-finders are such that only a very few instruments can be used. They must indicate the range mechanically and must be capable of being operated by one man. A limit must also be placed on their size. Horizontal base instruments capable of recording the ranges constantly are found to be the most suitable for all purposes.

The limits we are compelled to place on their size make the base very short and consequently the instrument is very inaccurate at long or even medium ranges. No makers claim a much greater accuracy than ten per cent for their instruments. From the table of danger spaces given above it is seen that the limit is reached somewhere between 2000 and 3000 yards for both the six-inch and the thirteen-inch guns. Again, the necessarily exposed position in which we must place these instruments renders them very liable to be placed out of action. On the whole not much reliance can be placed on them.

This unreliability renders it absolutely necessary that the instruments be supplemented by the second method, namely, the gun. Here also we are confronted with the difficulties of observation, but the possibilities of this method are greater than those of the mechanical means of range finding.

The use of the gun is very simple in theory but it is the practical application of this theory that is difficult. The method is to establish what is variously called a "fork" or a "bracket." The range must not only be found but it must be kept during an action.

The problem divides itself into two phases, for both of which the details have to be worked out.

The first phase is at the beginning of the action when it is necessary to determine the point at which to begin firing and this may be called the preliminary range finding. Before the action the range of opening fire will probably have been decided upon so that we will only have to determine when that point is reached. For this purpose a single gun may be used. The use of a single gun permits the observation to be more accurate and consequently the results should be better. When the ship has approached the opening range fire should be opened with one gun, the sights being set at the opening range. The observer notes the fall of the shot and communicates the results of his observations to the gun. Firing is continued slowly until the observer reports the shots

hitting. In this manner the opening range is correctly established. In the meanwhile the rest of the battery has been kept informed of the results, so that when the point of opening fire is reached they are ready. This preliminary ranging not only gives the opening range but also gives data which is available for finding the rate of change, which is a most important factor in keeping the correct range after it is once found.

As soon as the firing becomes general the use of a single gun, or group of guns, becomes well nigh impossible. The observer must now use the fire of the ship as a whole. For this to be of any advantage all the guns must be using the same range on their sight bars.

From the theory of probability we know that if all the guns are fired at the same instant, with the same range on the sight bars, and all correctly pointed, the shots will not fall in the same spot but will fall in an ellipse the center of which is the mean point of impact. In other words some of the shots will fall short and some over. The observer must use this fact, and if the shots are about equally distributed in "overs" and "shorts" he knows that the range is about correct. If none of the shots are short or none over then the range must be corrected accordingly.

The fact that one gun cannot be used in action to keep the range, but the fire of the ship as a whole must be used, is one of the greatest arguments in favor of central control.

There is a time, however, when it may be necessary for what might be called independent ranging; that is when both sides are engaged. In that event the attention of the observer must be given to the most important side and the other must rely on their own observation. This will probably not be so difficult, as the ranges will probably be quite short and the projectile can be followed in its flight.

In conclusion it must be said that neither method is entirely satisfactory but the use of the gun seems to offer the greatest possibilities; it requires, however, a large amount of training on the part of the observer. The fact that independent ranging must at times be used does not condemn the system of central control but merely shows that all the officers should have this training in observing and controlling the fire.

DISTRIBUTION OF DUTIES OF OFFICERS.

We have seen that the efficient use of the armament of a ship is in a great measure dependent on the amount of supervision and control given the fire of the individual guns, and all through this paper the effort has been made to work out plans for making the various parts of the ship's battery into one great effective whole. The necessity for communications, observation of the fire, and range finding, have been shown and plans outlined to obtain the desired results. No mention has been made of how to adapt these plans to existing conditions, in other words nothing has been said about the duties of the various officers who make up the ship's complement.

The ideal condition suggests a gigantic machine all the parts of which have been carefully fitted and adjusted and such should be the ship. There must be one difference, however, for our machine must be a thinking one and the personnel are all more or less important parts, each having his distinct function and duty. All training should be towards this desired end but we must recognize the fact that some parts of our machine may be broken and we cannot afford to allow a small break to wreck the whole structure; therefore, in our training, we must not only aim to get this machine-like precision but we must have our parts interchangeable, that is, if one link in our chain is broken, the two links on either side must be capable of closing up the gap thus left.

With this idea always in view let us see how we can best arrange the duties so that we will have our thinking machine.

The captain, as we have seen before, is alone responsible for the efficiency of his ship and must come first in all our considerations. What should his part be in our machine?

If in a single ship action, he must place the ship in the most advantageous position. If in a fleet action, he must keep his ship in the position assigned by the admiral and carry out all the orders that he receives. He must designate the target and the method of attack, that is he must decide upon the proper time to open fire, also the proper projectiles to be used by the various classes of guns. Briefly he must control the fire. It is evident, however, that he cannot actively exercise this control and at the same time attend to the other duties which devolve on him in action and his control must be through the staff which he would have to assist him. This staff should consist of the observation

officer or officers, and the central control station officer. The captain's duty then will consist in designating the target and the method of attack and the details must be left to his subordinates, the observer and the officer in charge of the communication system.

The gunnery officer is the most natural selection to be put in charge of the communication system. His duties would be to supervise the transmission of the ranges and orders to the various gun positions and to set the ranges from the reports received from the observers. In other words he is responsible for the execution of the orders of the captain in regard to the designation of the target, the projectiles to be used, the part of the ship that the various classes of guns are to attack, the ranges, and the corrections that are to be made for lateral errors.

The observer, as the name implies, must note the fall of the shots and generally observe the result of the fire of the ship. He must also transmit the results of his observations to the gunnery officer so that the latter may have sufficient data to keep the range intelligently.

The divisional officers are responsible for the execution of the orders conveyed to them. This is not all, however, for in case of a breakdown in the communication they must be able to take up the duties of the control and make the fire of their battery as efficient as the conditions will permit. They are also responsible for the proper handling of the guns in their divisions by the guns' crews and must be at hand to supervise them in case of accidents.

The question of centralization, as opposed to diffusion, of control once more comes to the front. Claims have been made that once the action is begun no central control is possible; therefore, it is better to have the gun as the unit instead of the ship. This view does not seem entirely sound, and surely, with efficient communications, there is no reason why proper control should not obtain.

It has also been maintained that the communications will be broken so early in the action that our central control will become inoperative. It must be admitted, however, that the efficiency of the fire is enormously increased while the communications are intact; is it not better to have this greater efficiency for a time, even if we do have to abandon it later on? Again it may readily

be the means of winning an action, for it is quite possible that while it is in use a supremacy of fire may be established which cannot but be of the greatest advantage. Another argument in its favor, if more are needed, is that at the beginning of an action when the ranges are long the fire cannot be observed with any degree of satisfaction from the gun positions (which is necessary in case our system of control is discarded).

To carry out the simile we have adopted, that of a machine, we may assume the division of the work to be as follows:

The captain is the operator, the rest of the complement the working parts. The gunnery officer having charge of the communications and therefore the fire control, another officer observing the fire, the divisional officers their divisions, and the guns' and ammunition crews the firing of the guns and the supply of ammunition.

TRAINING.

An effort has been made, under the heading "Observation of Fire," to show how difficult it is to make the correct deductions from these observations, and also the necessity for a large amount of experience in this important duty.

As has been shown, the best way to obtain this training is in observing the actual practice with the guns themselves. We have also seen that, with the limited amount of ammunition allowed, some means must be devised to supplement this practice in order to bring the officers who are to be entrusted with this work up to the highest state of efficiency.

The most natural solution of this problem seems to lie in the use of sub-calibre tubes in the great guns. These tubes should be at least one pounders. They are already fitted in the turret guns and could be very easily fitted in the 6″, 5″ and 4″ guns. One pounder tubes are suggested for the reason that the ammunition for them is comparatively inexpensive; three pounders, or better still six pounders, could be used and the training derived therefrom would be of greater value for the simple reason that the ranges used could be longer.

Using the one-pounder the fall of the shots can be seen up to about 2000 yards. It might be said that this range is very short and that little difficulty would be experienced in keeping the shots on. A little investigation will show, however, that the conditions

approach very closely long range firing, with the single exception that the observer can at this practice tell more about the fall of the shots. The sights of a 13″ gun, with 2100 f. s. muzzle velocity, would have to be set at 5350 yards, and with sights graduated for 2350 f. s. initial velocity, the velocity this gun gives using smokeless powder, this sight bar range will be something over 6000 yards, or about equal to the outer limit of range that we have established as being effective. The sights would then have to be changed in a similar manner to that used when firing at long range with the guns themselves, which is the practice we desire.

If it is admitted that we have a means of developing our system of observation, by the use of sub-calibre attachments, let us consider the training to be used.

Like any other training this must be progressive, and we cannot hope to find ourselves proficient at once.

As a first step send out a target and anchor it at some unknown distance, within the outer limit of our range (2000 yards). When the target is planted and the observer is ready, commence firing, the ship remaining at anchor. It must be remembered that at this range instruments are fairly accurate, but at the ranges this practice is to represent, say 6000 yards, they are of little value, hence their use should be forbidden. Another reason for not using range finders is that the practice is to give the observers experience in finding the range with the gun alone.

Let us assume this problem: To find the range with the gun alone.

Following out the proposed system the observer assumes the range to be say 4500 yards, which of course should be as close to the actual range as possible, preferably a little short. Orders are given to set the sights at this range; one shot is fired from the battery or from a number of guns. The "bracket" is at once put into use and the firing continued until the range is found. This practice is continued until a fair amount of expertness is obtained.

The next step is to anchor the target as before and to get the ship under-way. Steam towards or away from the target at a known speed. This allows the observer to know the rate of change of the range. Continue this practice until the observer becomes expert not only in finding the range but in keeping it.

Then comes the final step, which is made to approximate, as

closely as possible, the conditions of battle, namely, where the speed is not only known but also varies from time to time. The bearing of the target should also be changed for this will give practice in correcting for lateral errors.

In action a knowledge of the relative speed alone, of the ship and the target, and not the actual speed is necessary. From this it is evident that the method of range finding is the same and it is only the execution that is more difficult; it is not at all necessary to have the target moving, for the conditions may be simulated by varying the speed of the ship and changing the bearing of the target.

The target used in this practice should be a regulation great gun target or even larger, so that we may not be dependent on the fall of the shots for our knowledge of the expertness of the observer but can count the number of hits on the target and thereby tell positively.

LONG RANGE FIRING.

In another part of this paper a table has been given which shows the danger space, for the 6″ and 13″ guns, at the various ranges from 1000 to 7000 yards, for a thirty foot target.

The term "danger space" may be expressed in different words by saying, that in order to hit the target, we must know the range within certain limits.

Looking at our table we see that for a six-inch gun, at four thousand yards, this is 138 yards, and at five thousand yards it is 90 yards.

With a ship steaming towards or away from the target, at ten knots, the range changes about six yards per second.

From this it is easily seen that, at five thousand yards, if the gun is not fired within fifteen seconds from the time the sight is set, a hit cannot be made. At six thousand yards the time in which we have to fire, after the sight has been set, is even less.

From the above the natural conclusion to be drawn is that, at ranges of four thousand yards and above, we must have our sights correctly set at the moment of firing or at least they must be correct within the limits of the danger space at the firing range.

It is evident then that the sights must be set at frequent intervals, and, in order to do this correctly some empirical rule must

be established which can be followed closely. The observation of the fire will serve to correct this.

The means which suggests itself of having the correct range on the sights at the moment of firing is to have the sights set at given intervals of time, say every fifteen seconds, and allowing the pointer to fire only during a given period. This plan necessitates some method of keeping time so that the sight setter will know when to set his sight. Time keepers could be had at each gun and their duty would consist in notifying the sight setter when to set the sight, but such a scheme would be most cumbersome. A better one seems to be to have the time kept at the central station, and, by means of electric bells, marking the time.

The practical working of this plan is that an automatic timekeeper would ring bells at the various gun positions. It would consist of a clockwork arrangement which could be made to make the signals at fixed intervals and for certain periods of time. When the bell stopped ringing, this would be the signal for the sight setter to change the sight.

This system might be carried a bit further and the bell be rung for a certain period of time, depending on the range; this would then be a signal to the pointer that his sight was correctly set and that he could fire during the time that the bell was ringing. As stated above when the bell stopped the sight setter would at once make the change and the sights would then be correctly set to commence firing at the next signal.

At three thousand yards it requires thirty-eight seconds for the ship to run a distance equal to the danger space; hence if the sights were set every thirty seconds they would be sufficiently correct, during the entire interval, to ensure a fair percentage of hits and it would only be necessary to give the time signal.

As the ranges decrease this interval becomes longer until we reach the short ranges when it is desirable to deliver the greatest volume of fire.

THE PROPOSED AND PRESENT SYSTEMS—A COMPARISON.

The essential features of a proper system of fire control having been pointed out, let us now see how this compares with the methods now employed in our ships.

The centre about which the whole scheme, as outlined, revolves is communications; if they are lacking the whole structure falls.

At present our system of communications consists of telephones, voice pipes, (both of which have been shown to be entirely unsuited to our purpose), and what are called "battle order" and "range" transmitters and receivers.

These transmitters and receivers are electrical, which is considered the best type, but they are not entirely satisfactory in their design. For example the range receiver shows no range less than one thousand yards and the smallest division that can be indicated is two hundred yards, which we have seen is barely small enough for the very moderate range of three thousand yards.

Again one transmitter serves for all the receivers and no provision is made for sending discriminating orders to the different types of guns.

On the whole our present communications will not permit our using the system of fire control which we have outlined, and some improvements must be made.

This improvement is more a question of amplifying the present system than of changing it completely, although the design of the instruments needs changing.

CONCLUSION.

In this paper an effort has been made to show some of the advantages of an efficient control of the gun fire of a ship. With that end in view the conditions have been discussed and the means of fulfilling these conditions have been outlined.

The most important part of the whole system is undoubtedly efficient communications and next to that observation of the fire.

All the officers of the ship should be given the necessary training to be able to fill this most important station with ability but if other conditions make it impracticable for all to be so trained, then it is essential to have certain officers become proficient in this branch.

Looking at the subject of naval warfare from a general standpoint, it seems that most of our thought and energies have been directed towards the improvement of the mechanical side of the question and too little thought has been paid to developing the personal element which must in all cases be the deciding factor in any action in which the engaged forces are at all equal from the mechanical side.

The ultimate end of the establishment and maintenance of a navy is to be in a position, when the occasion arises, to deal a death blow to the enemy. To do this we must rely on our gun fire, as that is our principal weapon of offense, therefore let us bend all our energies to developing to the greatest extent this weapon. In other words let us make each ship an efficient whole by welding together the units with an efficient system of fire control.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

WAR AND ITS PREVENTION.*

By REAR-ADMIRAL S. B. LUCE, U. S. N.

War is one of the great agencies by which human progress is effected.

Scourge though it be, and much as its practice is to be deplored, we must still recognize war as the operation of the economic laws of nature for the government of the human family. It stimulates national growth, solves otherwise insoluble problems of domestic and political economy, and purges a nation of its humors. According to an ancient proverb, *Purgamenta hujus mundi sunt tria, pestis, bellum, et frateria.*†

War is the malady of nations; the disease is terrible while it lasts, but purifying in its results. It tries a nation and chastens it, as sickness or adversity tries and chastens the individual. There is a wisdom that comes only of suffering, whether to the family or to the aggregation of families—the nation. Man is perfected through suffering.

What is true of the average individual is true of the mass of individuals—the people.

Some of the richest contributions to literature, art, and science have been the offsprings of indigence. Want brings out the natural gifts that affluence stifles. So, in the economy of nature, or the providence of God, war is sent, not necessarily for the punishment of national sins, nor yet for national aggrandizement; but, rather, for the forming of national character, the shaping of a people's destiny, and the spreading of civilization.

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*Reprinted, by permission, from *The North American Review* of December, 1891; where it appeared under the misleading caption of: "*The Benefits of War.*"

†Frateria: Monk latin, meaning Monastic seclusion.

It is only through long years of severe trials and tribulations that many men and women have been schooled to ultimate success. So nations, before achieving greatness, have had to struggle through periods of bitter strife before the various factions, with their conflicting interests, have been formed into one homogeneous mass.

As adversity and opposition toughen the mental and moral fiber and temper the spirit of man, so riches and easily acquired success enervate the strongest character and unfit it for protracted effort. It is the same with nations. War arouses all the latent energies of a people, stimulates them to the highest exertion, and develops their mental and material resources.

History presents few finer pictures than that of the Roman Senate thanking Varro at the city gates because, after Cannæ, "he had not despaired of the republic." Steeled by incessant warfare to an inflexible resolution, not gold, but Rome's best blood, was named by those stern Senators, in that desperate hour, as the price of liberty.

But the "cankers of a calm world and long peace" atrophy the active forces, and luxury becomes more destructive than the sword.

Rome, once mistress of the world, the seat of arts, empire, and glory, fell by corruption to a state of sloth, ignorance, and poverty. From "virtuous industry," says the historian, "it passed to wealth; from wealth to luxury; from luxury to an impatience of discipline and corruption of morals; till, by a total degeneracy and loss of virtue, being grown ripe for destruction, it fell at last under the hand of the oppressor; and, with the loss of liberty, losing everything that was valuable, sank gradually again into its original barbarism." Such is the law of the rise and fall of nations.

But for war the civilization we now enjoy would have been impossible. The swath cut by the reaper's sickle through fields of ripened grain is not more marked than the way cut by the sword for the path of human progress. "Westward the star of empire took its way," for westward set the tide of conquest.

The imposing wave of barbaric triumph swept from Asia across the Ægean Sea, only to be turned back by united Greece armed in the sacred cause of liberty. The battles of Marathon, Salamis, and Platæa were only so many stepping-stones towards an ascendency

of Hellenic civilization, the influence of which on human affairs can never die. Without war Greece would have lived on æstheticism and wasted its life in idle dreams.

The overthrow of the Persian Empire by the trained soldiers of Macedonia, it has been well observed, is the first great revolution in the affairs of mankind of which we have knowledge. The fall of Carthage and the elevation of Rome from the same cause —disciplined troops—are the second. These were great strides in the course of human progress. Hannibal's long and devastating campaigns in Italy moulded through years of battle the martial Roman of a later day, as already noted, and prepared the City of the Seven Hills, as no discipline but war could have prepared her, to reign mistress of the world, and give laws and letters to nations then unborn. "No power," remarks a modern historian, "was ever based on foundations so sure and deep as those which Rome laid during three centuries of conquest."

Says a profound student of biblical literature: "The world, before it was ready to accept Hellenism and Christianity, had to be prepared and made smooth for centuries beforehand. A great humanizing force had to be created—a force powerful enough to beat down the obstacles which local patriotism offered to the idealistic propaganda of Greece and Judea. Rome fulfilled this extraordinary function. Rome, by prodigies of civic virtue, created the force of the world, and this force served to propagate the work of Greece and the work of Judea—that is to say, civilization." The Roman legions supplied the force.

The eagles of Cæsar spread through western Europe, and among the rude Britons, the seeds of civilization, and prepared the way for higher forms of political life. Later on, generations of fierce contention between the Dane and the Saxon, Angle and Norman, on the soil of Britain, fused these various peoples into the English-speaking race of the present day. Thus by war were amalgamated three branches of the great Teutonic family with each other and with the original Briton. The Great Charter, wrung from King John by those iron barons, "sword in hand." as Sir William Blackstone tells us, united the Normans and the Saxons and forms the first chapter in the history of the English nation. The Great Charter and the Bill of Rights, and the principles of civil and religious liberty they embody, are the priceless heritage of every American. Their full enjoyment, it must be

remembered, cost "rivers of English blood." Transplanted to the shores of America, those principles assumed, according to the law of evolution, still higher forms; but their possession had first to be won and then maintained by the sword.

From the "blue Cyclades" to the slopes of the Pacific, war has made possible the slow, but certain, development of the great law of human progress, and of the principles of democracy. The operation of this law is not to be arrested on the hither shores of the Pacific; nor is history to be turned back. The course of empire still holds its accustomed way. With the United States, as the dominant power of the western world, lies the obligation of contributing her share to the further extension of civilization, to the spreading of the Gospel, and conveying to less favored nations the most enlightened views of civil government. Peaceful commerce is one of the forces by which this end may be attained; and the Pacific and its further shores the field of its operations. This splendid work our people are now content to leave to England and those most effective missionaries, her military and mercantile marines. The time will come, however, when the nation, in its manhood, will "put away childish things," assume its own high responsibilities, and organize its forces for practical use.

We are far from maintaining that war is the only agency through which the present advanced state of civilization has been reached. Christianity has been, and must continue to be, an indispensable factor. But the sword has ever preceded the banner of the cross. Indeed, Christianity, as we shall see, has often had to work its own way through the instrumentality of the sword.

Commerce is another great factor. By it civilization is carried over wide seas to distant lands; but commerce owes its extension and protection to the military arm of the people it represents.*

Wars have sometimes been precipitated in spite of all human efforts to prevent them. As in the presence of the convulsions of nature man feels his utter nothingness, so in the great political and religious movements which have marked certain epochs in

* It seems like uttering a platitude to quote De Tocqueville's remark that "reason and experience prove that no commercial prosperity can be durable if it cannot be united in case of need to naval force." ("Democracy in America.") His prophecy that "America will one day become the first maritime power of the globe—they are born to rule seas, as the Romans were to conquer the world," will doubtless be fulfilled in time.

history, man has found himself impotent to either control or guide the march of events. It is then that he acknowledges that human affairs are directed by a power above and beyond this world, for the ultimate good of his race. Such was pre-eminently, the case in this country in 1861. It was so in England in 1642. That revolution which "taught Englishmen what good government meant," and is part of the history of this country, was the natural fruit of the Reformation. It was the first collision between freedom of inquiry and absolute monarchy. In the impulse which was given to human thought, and in the abolition of absolute power in the spiritual order, the Reformation, we are told, accomplished far more than it had undertaken or even dreamed of. It failed to even comprehend the vast extent of its own work. It did not respect the rights of opinion. At the very moment of demanding those rights for itself, it was violating them towards others. Great as its work undoubtedly was, it could be completed only through the agency of the sword.

That protracted and bloody drama, the Thirty Years' War, which in the name of religion devastated and impoverished Germany, saved Protestantism from obliteration, insured religious toleration, and opened the way to the German intellectual life of a later time.

The net results of Napoleon's campaigns were to break up the system of petty states in Germany and Italy, "to reawaken the spirit of inquiry in the people, to sweep away the relics of an effete feudalism, and leave the ground clear for the growth of newer and better forms of political life."

Our own Civil War furnishes as notable an example as may be found in history of the operation of this law of strife by which human progress is effected. War was the only means of solving the great political problem of the abolition of slavery, and the phenomenal progress, not of the South alone, but of the whole country, during the past twenty-five years, bears abundant testimony to the quickening influences of that momentous struggle.

Heaven forbid that we should even seem to be an advocate of war. We are not an advocate of war, nor of pestilence, nor of famine. On the contrary, we join with the church in praying for deliverance from them. But this is not a question of what one could wish: it is a question of a great fundamental truth.

From constantly recurring phenomena of the same class covering periods marked by centuries, and the tendency of the

same phenomena at the present time, we are enabled to arrive at certain laws. Thus from the frequency of wars both in ancient and in modern times, even up to the present writing, and from the marked influence those wars have had on national life and character, it is impossible to escape the conviction that they are the results of fixed laws, and not the products of human institutions established, and admitting of being abolished, by the commonwealth of nations.

Strife in one form or another in the organic world seems to be the law of existence. "Life," the scientist tells us, is but "the sum of all the forces that resist death." Suspend the struggle, well called the battle of life, for a brief space, and death claims the victory. The struggle begins at birth, and ends in one unvarying way at the grave.

In the battle of life there are two distinct lines of operation—that which has to do with physical and that which has to do with moral laws.

In this way it comes that a man finds himself at war first with himself, and then with his neighbor. The supreme law of self-preservation compels a man to obtain his daily bread. Acquisitiveness begets avarice. To save his darling treasure a man will defraud his brother; hence family feuds. From inherent weakness and clashing of opinion there are bitter contentions among churchmen; among congregations and their pastors; among Christian associations of various kinds. Strife is continual and everywhere in this wicked world. In the sublime vision of St. John the Divine, there was war in heaven when the archangel Michael and his legions of angels fought against the dragon, which is the evil one. It was the strife between the principle of good and principle of evil; and where is that strife maintained but in the human heart? St. James asks of the turbulent Jews of Palestine: "From whence come wars and fightings among you? come they not hence, even of your lusts that war in your members?" And St. Paul, writing to the Christians in Rome, struck the same keynote of human passions: "I see another law in my members, warring against the law of my mind, and bringing me into captivity to the law of sin which is in my members."

It would be difficult to find in sacred or profane literature a clearer expression than St. Paul's of this fundamental law of human nature. As long as that law remains unchanged, just so long may we look for an inward conflict going on in every human

bosom, and the predominance in one individual or another of the principle of good or the principle of evil; and just so long may we look for covetousness and envy, and for dissensions among individuals, communities, and nations.

By the very law of our nature, it thus appears, the well-spring of war is in the human heart. When the apostle of universal peace can change human nature itself, then may he hope to put an end to war. The utmost that we can now reasonably hope for is to lessen the frequency and the evils of war.

Sadly enough, religious wars are the most relentless; and the darkest and bloodiest pages of history have been recorded in the name of him who taught and practised the divine law of love. And yet, was it not even he who said, "Think not that I am come to send peace, . . . but a sword?"

It has been said that it was one of the greatest reproaches to human nature that wars are sometimes just; and the author of "Gesta Christi" complains that there is "one field where Christianity seems a failure." "War," he says, "still remains the most fearful curse upon mankind." On the same grounds we may regard disease as a reproach to human nature, and charge inadequacy to the Christian religion because we have such dreadful railroad accidents. Christianity, we apprehend, has to do with the regeneration of the human heart, and not with the laws of nature. "Nation shall rise against nation, and kingdom against kingdom; and there shall be famines, and pestilences, and earthquakes, in divers places." But "be not troubled," said the Holy One of Israel; "for all these things must come to pass." We are told, it is true, that there is a time coming when war shall cease. "Love is the fulfilling of the law," declared our Divine Master. That is to say, when the human heart shall have become regenerate, the prophecy will be fulfilled that the sword, the emblem of war, shall be turned into the ploughshare, the emblem of peace, and spears into reaping-hooks. "Nation shall not lift up sword against nation, neither shall they learn war any more." Then that "old serpent which is the devil" shall be bound for a thousand years, and "deceive the nations no more till the thousand years be fulfilled." But Satan, still unbound, ceases not "from going to and fro in the earth and from walking up and down in it," and "deceiving the nations."

Contrary doctrines, founded on denunciations indiscriminately

heaped upon the practice of war by various writers at various times, have been frequently expressed in recent years. The late Dr. Francis Wayland, in his "Elements of Moral Science," laid down the the broad principle that "all wars are contrary to the revealed will of God.* Starting with that assumption, it is argued that the law of human progress is leading man to a state of moral perfection on earth; and that, because of the wonderful advances in the arts and sciences which have characterized the age, we must be rapidly approaching that blissful state. Orators find this a popular theme; people like to hear it. But the connection—say, rather, the disconnection, or, truer still, the antagonism—between material prosperity and spiritual growth is not made clear.

Of the whole range of sciences, moral science, founded on Christian ethics, on which the attainment of the earthly Eden depends, has made no progress in eighteen hundred years. The principles governing the moral world were laid down by the great founder of our church in the beginning, and left nothing to be said, no improvement to be made. He distinctly stated, moreover, and all his teachings went to show, that his kingdom was not of this world.

Even the preparation for war has been denounced. "From a general comprehension of the war system," said Charles Sumner, —and he has hosts of followers,—"we perceive the unchristian character of the preparations it encourages and requires."† But, according to Moses and the prophets, God himself worked out, through the agency of war, the destiny of his own chosen people. And our Saviour, so far from condemning war, counselled a wise prudence in regard to all worldly affairs. "What king," he asked, after his wonderful manner of conveying lessons of the most profound wisdom,—"What king, going to make war against another king, sitteth not down first, and consulteth whether he be able with ten thousand to meet him that cometh against him with twenty thousand? Or else, while the other is yet a great way off, he sendeth an ambassage, and desireth conditions of peace."

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* It is only fair to state that during the Civil War Dr. Wayland became convinced of his mistake in this particular. But his work had long been used as a text-book in our schools, and the influence of his erroneous teaching on the subject referred to is still felt.

† Address before the American Peace Society, May 28, 1849, on "True Grandeur of Nations."

It was by war and pestilence that the children of Israel were disciplined. "If ye rebel," was the divine mandate, "ye shall be devoured with the sword: for the mouth of the Lord hath spoken it."

Moses, the greatest military leader of ancient times, conducted his campaigns in accordance with the instructions received from God himself. For he had found grace in the sight of the Lord, who spake to him face to face, as a man speaketh to a friend. Deborah, the prophetess, and Barak, son of Abinoam, sang praises to the Lord for their victory over the Canaanites. "They fought from heaven" is their song. "The stars in their courses fought against Sisera." "The Lord is with thee, thou mighty man of valor," is the salutation of the angel to Gideon, as he was threshing wheat. Jephthah, receiving assurances of divine support, went out and defeated the sons of Ammon. Sacred history resounds with the clash of arms and the songs of triumph; and lurid beacon fires, streaming through the soft Syrian nights, frequently call God's people to war. The result of all these conflicts furnishes one of the most remarkable chapters in the history of the human race. From the lowest and most abject state of Egyptian bondage, the children of Israel were trained by war to become a powerful race, to take their stand among the nations of the earth, and give to all succeeding ages, in an imperishable literature, the principles of the highest civilization.

The ancient and "immovable civilization" of China, on the other hand, shows the stagnation of a people unaccustomed to war with a superior race. China, to-day, presents a picture of what the modern world would have been without war.* The rights of man are there unknown.

War is certainly a great evil, and abhorrent to every right-minded person. So is small-pox. But it is not the greatest evil. Milton said, during the Commonwealth, that civil war was not as great an evil as a tyrannical government. "When the devil of tyranny," said he, "hath gone into the body politic, he departs not but with foaming and great convulsions: shall he, there-

*The *modern* world. The civilization of China probably represents that of the Chaldeans, of about the time of the destruction of Jerusalem, 588 B. C. The wars which China has engaged in with England and with France, while too restricted in their sphere of action to affect the mass of the Chinese people, have undoubtedly had a marked local influence.

fore, vex it forever, lest in going out he, for a moment, tear and rend it?"

The proper spirit in which to consider a great evil is to look it in the face, examine into its origin, and seek the causes which lead to its production. If these causes lie in the operation of the laws of nature, which cannot be influenced by human action, then we must endeavor to modify the effects and ameliorate, as far as lies in our power, the conditions to which they give rise. Man cannot control the meteorological laws which manifest themselves in cyclones; but he can build ships and houses strong enough to withstand their violence. Medical science cannot conquer death, but it has done much to alleviate suffering; and statistics show that the average duration of human life has been increased through increased knowledge of the laws of hygiene. Moral science cannot boast of a like achievement. It has been stated on good authority that, while the population has increased 30 per cent from 1870 to 1880, the number of criminals in the United States has increased 82.33 per cent. Immorality and crime are on the increase. This fact, coupled with those of the centralization of wealth and the interminable conflict between capital and labor, makes a gloomy outlook for that brotherhood of man which is to form the basis of universal peace.

Questions in medical science are submitted to rigorous investigation according to scientific methods. Questions in moral science are too often treated from a sentimental standpoint, or quietly ignored. Even in this enlightened age we seek to eradicate the "great social evil" by shutting our eyes to it. There is a widespread disposition to treat war in the same way—by shutting the public eye to it. What progress had pathology made by that method?

It is the popular and very proper thing to say that the progressive spirit of the age is leaving the barbarism of war behind, and that as civilization advances it will learn less of war. Arbitration is now the sovereign panacea for that national ill. But, as a matter of fact, war has never been so carefully and systematically studied as at the present time. The genius of invention has never been so prolific as now in devising and improving implements of war. That man is honored and enriched who contrives means of destroying the greatest number of human beings in the shortest space of time. As the conduct of war becomes more scientific, and the art becomes refined, and the im-

plements more destructive, the recurrence of war is lessened, the duration shortened, and the loss of human life diminished. This is the direction the spirit of the age is taking—a direction in the interests of humanity.

These humane conditions, however, involve an advanced stage of preparation. As a science war should be sedulously cultivated by the few qualified to undertake it; as an art it should be constantly practised by the entire body set apart for that purpose, and with the implements actually to be used in war. It is to this state of preparation that we owe the peace of Europe today. The mere presence of the American army on our southern frontier in 1866 was sufficient to cause the collapse of Louis Napoleon's scheme for a Mexican empire. By a perfect state of preparation a collision of arms was avoided and the shedding of blood spared. The question of an empire in Mexico supported by French bayonets was not one for arbitration. We simply would not have it.

To be unprepared is wicked. It invites aggression and a useless effusion of blood.

There is a certain class of international questions for which arbitration is admirably suited; there is another class for which it is not suited at all—for which it is totally inadmissible. It is the lamb that advocates arbitration, even though the life and honor of the fold be involved, while the wolf maintains a lofty indifference to all such methods of proceeding.

Venezuela has been for years past supplicating for arbitration on the question of boundary between her own territory and that claimed by England; but it is only within the last few months that the latter power has, according to report, formally declined the good offices of the United States in that controversy.

Arbitration was inadmissible in 1860-61, when so sorely needed. War, which had been in the course of preparation for thirty years preceding its outbreak, was the only solution of the great problem. It had to be.

Arbitration fails miserably when most needed, and what wonder? The high contracting parties and their umpires are all men of like passions, having no court of last resort but the battlefield.

Every Christian, whatever may be his private convictions, must hope and pray for the success of the Universal Peace Association and the sufficiency of arbitration in all international disputes. But no American, be he Christian or not, should forget

the moral effect on negotiations of the propinquity of an adequate force. It was the moral as well as the military effect of a large and victorious army on the Rio Grande that caused the withdrawal of the French army from Mexico. The hopelessness of a conflict with the veterans who had fought under Grant and Sherman was felt, not only in France, but throughout all Europe, to an extent difficult at this day to realize. But that that moral effect has, during the past quarter of a century, waned away is just as certain as it is that the vast military force which produced it has resolved itself into its original elements of peaceful and industrious citizenship.

The United States are known of all the world to be wanting in the disposition to utilize their abundant resources for military purposes—not with a view to conquest, but even for the defenses suggested by the most ordinary prudence. Ready as they are to wage a commercial warfare, our people close their eyes to the possibilities of an actual collision of arms.

There are false prophets who proclaim that war is to be abolished and that preparation for war is a useless extravagance; who offer a cheap nostrum for a dreadful disease. Out of that fearful concatenation of evils set forth in the solemn litany of the Holy Catholic Church of America, wherein we are taught to supplicate deliverance from sin; from the crafts and assaults of the devil; from plague, pestilence, and famine; from battle and murder, and from sudden death, they select battle alone for extirpation. Why should they not include sin as well? Why not include the whole dreadful catalogue? Why not form an association for the suppression of all inordinate and sinful affections?

The truth is that war is an ordinance of God. The flaming sword that guards the way to sinless Eden will continue to prevail, until man enters once more into that peace which passeth all understanding, when the lust of the eye and the pride of life shall no more be known. But mortal man cannot yet discern the coming of that day.

Meanwhile let practical America recognize the truth that war is a calamity that may overtake the most peaceful nation, and that insurance against war by preparation for it is, of all methods, the most business-like, the most humane, and the most in accordance with the teachings of the Christian religion.

DISCUSSION.

THE FLEET AND ITS PERSONNEL. See No. 109.

Lieut. YATES STIRLING, JR., U. S. Navy.—Lieutenant Fullinwider's essay on "The Fleet and its Personnel," hits a synchronizing cord in every officer of our navy. Every one will say to himself after reading the article, "that is just what I have believed for years," or, "that is just what I have advocated since the rehabilitation of the navy," but nevertheless, this subject, so vital to our country which must, in spite of all opposition from dissenting parties politic, maintain the position it has won by the sword among the world powers, has been left to a young but very able officer to state clearly and concisely before the country. The white man's burden of colonization has been securely strapped to our back. We must bear it, and for our self-respect and that of the world, we must carry it without staggering.

(1) *Administration and Organization.*—This is the deep pit into which our navy has fallen and it looks as if the sides were too high and steep for it to get out without assistance from above.

A general staff, composed of the most intelligent officers of the service above the rank of commander, Lieutenant Fullinwider believes, could get us out of the pit. True, we should have such a staff or body of *sea going* officers, who will represent all that is best in the personnel of the navy, whom Congress will have confidence in, and when these men hand in their carefully worked out notes to the Secretary of the Navy, and he goes before Congress to give testimony on the Naval Appropriation Bill, no such discussions as we read in the newspapers would occur. Our Congress is an able body of men, men of all callings. They would say: "This plan has the support of those men of our country who are best able to know what is good for our naval establishment; they have given their life study to this particular subject; they are authorities, quoted all over the world, familiar with every conceivable engine of modern maritime warfare; they tell us we need so many ships of such and such a class and an increase of the personnel to correspond; we know our country needs a navy second to none in the world and a personnel as efficient as our ships are formidable; this is a national issue, local politics should not enter into discussion; we are the guardians of the country's treasury and the nation demands we use it for the common good. We are not naval men. This body of highly trained men show us wherein our duty lies; useless discussions will do no good, this bill as it stands should be passed." If this state of affairs could be brought about, the navy, phœnix-like, would rise from her ashes and the richest country in the world would have a navy that would make our flag respected in every country on the globe and would be an insurance on the many millions of United States gold invested both at home and in our island possessions.

(2) *Organization of the Present Fleet.*—This plan is practicable and feasible and should be carried into effect at once.

Our prestige abroad has been hurt in many ways by the lack of system of organization of our present squadrons. To a naval eye it is ludicrous to see the many classes of vessels in a single squadron. No battery alike, and of vastly different manœuvring qualities.

(*3*) The "Home Base" idea is an excellent one and should prove of the greatest benefit to the service. The only thing to guard against in buying the land will be to see that sufficient ground is bought and that the grog shops and low dives that always cluster about a government reservation are kept far enough away so as not to become a common nuisance. When one of our navy yards was bought the government saw fit to get just as little land as it could, with the consequence that these places sprung up in such close proximity that it has been recommended to buy more land at a tremendous cost in order to protect the water supply and more fully guard government property. The whole peninsular on which the navy yard is situated could have been bought for little or nothing at the time the yard was founded, but this comes from a lack of policy.

(*4*) *Building Program.*—This hits the mark exactly. Why not advocate 47 battleships to be named after the 47 states, changing the names of the monitors to Indian names? Why would it not be a good idea for each state to look out for the welfare of its battleship? When it becomes antiquated, then the state's prestige is hurt, and it will use all influence it can bring to bear in the national Congress to have it replaced by a more modern one; however, this brings in local issues into national ones, which in general should be avoided.

The small gunboat proposition is good. They should be kept in hand for revolutions in South and Central America and other times when a single ship only is needed, instead of breaking up a squadron into its units when a demand comes for several ships at different places. At present the cruiser squadron on the Asiatic station, which by order of the department was always to cruise in company, is distributed to widely different parts:

1..... Chefoo,
1..... Shanghai,
1..... Chemulpo,
1..... Manila.

If we had gunboats sufficient for this work the department would be able to carry out its own plans. Building ships with no military value is like throwing money into the sea. The time is passed for training sailors. Men of a mechanical education are desired; a slight knowledge of seamanship is required in the way of knotting, splicing and serving, but this can be acquired on a ship with a fighting value just as well.

In regard to the 3500 ton, 25 knot, scout cruisers, a comparison of tonnage and speed does not show us that they could fulfil one condition vital to scouting; their coal capacity would necessarily be limited, giving then but a small radius of action. A plan which has recommended itself to England, Germany, France, and last but not least, Japan, that of subsidy, should recommend itself to every American and would prove most bene-

ficial to both our merchant marine and navy. Instead of having to build and keep up a large fleet of scouts, vessels with very little fighting value, useful only in time of war, we could rely on the large steamship companies to build a large fleet of fast mail steamers, run and kept in repair by the several companies, on board of which would be trained men, available in time of war, with no cost to the government except the comparatively small subsidy paid each year. These fast steamers could at any time be taken over by the government, crews and all, and we saw, in 1898, how useful they are as scouts.

(5) *Enlisted Personnel.*—The essayist is right; the apprentice system has of late years proved a failure; the reasons are fundamental and can only be remedied by a change of system. One thing can not be eradicated even by this change, and that is, a mechanical man demands a high price ashore and naval men after one, or at least two cruises, turn out to be good mechanical men, dynamo tenders, mechanics in gun and arm factories, etc. Of late years the demand for such men has been great and there is where our best men are going. Of course they will return in time of public danger, but it is feared that they are lost to us until such time. Maybe, as Lieutenant Fullinwider says, if the navy can be made more attractive to them by the establishment of Home Bases, giving them a taste of domestic life, a great many good men may be spared to us.

Agreed, with the essayist, in regard to using the converted merchant ships as training ships. What an awakening it must be for a young man fresh from one of the Western States where he has been lead to believe that the United States is one of the greatest countries in the world, put on board an old merchant cargo steamer with a few guns, for his first training cruise. He goes into foreign parts and sees fine men of war in homogeneous fleets or squadrons, with flags flying over them belonging to countries he has been told are second or third rate in international affairs. This may not cause many desertions, but it has a bad effect on the recruit. It is, nevertheless a bad policy to keep such ships in commission at a time when there is a demand for more officers and men on ships having a fighting value. These converted merchant vessels mentioned above have been used in our manœuvres in the West Indies, having been given positions in a paper fleet of battleships and armored cruisers; the manœuvres were, by many officers participating, likened to playing dolls. If we wish to have manœuvres, and we all know we need them throughout the service, well! take the tools we have in hand and use them in earnest, relegate the merchant ships to transports and hospitals ships, but do not attempt to give them the traditions of a man of war; they are, using a jacky expression, "mushroom ships," and their crews, no matter how good the material, are bound to be mushroom crews.

(6) *Officers' Training.*—Officers should be trained and encouraged to take up specialties. We have delusioned ourselves into thinking that each man in the navy could do every other one's duty. You can legislate a line officer an engineer officer, but he still remains a line officer or vice versa, and in consequence our navy has come face to face with a very grave peril; lack of engineers and ordnance officers. Three years ago

some one woke the Ordnance Department up to the fact that they had been asleep for nearly five years. This Rip Van Winkle policy is dangerous in these progressive days and can be guarded against only by organising corps of officers to be the watch dogs over their several specialties, and they are to keep the sea going officers informed of what is going on ashore and the sea going officers must reciprocate. They should take their turn afloat, but only on ships where their specialty will be benefitted. There is a subject that Lieutenant Fullinwider does not mention. It properly belongs under the head *Building Program*. It is this: Our naval constructors have too much power. The advice of those who use the ships is totally disregarded by a body of theoretical men who will believe nothing unless it can be proved by mathematics. If some system could be devised to give the naval officers who go to sea in the ships, a chance to have changes made that they see are necessary before the ships are built, a good deal less money will be spent on changes afterwards.

The present steam launch used in the navy is unseaworthy and unfit to be carried by a large ship. Officers have time and time again recommended a change, but we still have the same unseaworthy article.

In conclusion, Lieutenant Fullinwider does not mention the growing evil of frequent shifting about of officers and men. This is a death blow to the efficiency of the fleet.

The British system of a commission of a ship is the plan that we should adopt at once, keeping officers and men together in the same ship for three or four years.

PROFESSIONAL NOTES.

Prepared by Professor PHILIP R. ALGER, U. S. Navy.

SHIPS OF WAR, BUDGETS, AND PERSONNEL.

AUSTRIA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Erzherzog Karl.....	10,600	Trieste.	Launched Oct. 4, 1903.
Erzherzog Friedrich ...	10,600	"	" April 30, 1904.
[illegible].....	10,600	"	Projected.
Babenburg....	8,340	Pola.	Under trial.
Armored Cruiser.			
Saint Georg	7,400	Pola.	Launched Dec. 8, 1903.
River Monitors.			
Save..... ...	450	Neupesth.	Launched March 25, 1904.
Theiss.....	450	"	" " " "

The budget of the Ministry of Marine has been passed, as well as an extraordinary vote of 75,000,000 kronen. In addition to 8 new torpedo-boats of an improved type, with engines developing 2000 I. H. P., giving a speed of 26 knots, the construction of all the new ships is to be hastened. When defending the increased outlay before the delegations, Admiral Baron Spaun, the Minister of Marine, stated that "with the new credits, in a year and a half we shall have the same number of battleships as we had in 1870; but without them we should have had to wait eleven years for the reconstruction of the fleet." The Minister further explained that, as the result of the lessons of the Russo-Japanese war, a considerable sum must be expended on the better protection of the harbor and roadstead at Pola. He also stated that it was intended to construct one submarine for experimental purposes.

THE PERSONNEL AND MATÉRIEL OF THE FLEET.—The whole *personnel* of the fleet actively employed amounts to 10,906 officers and men, of whom 3122 officers and men are employed on shore service and 7784 afloat.

201 officers are employed on shore service, of whom 31 are employed at the Ministry of Marine in Vienna, including 1 admiral, 1 vice-admiral, 1 rear-admiral, 4 captains, and 6 commanders.

272 officers (including 2 rear-admirals) and 2578 men are employed in the Adriatic and Mediterranean Squadron; 128 officers and 1301 men are employed in ships on foreign service; 221 officers and 3284 men are employed in the training and harbor ships.

The total number of officers employed is 1442, with 9464 petty officers and men.

The *matériel* of the fleet, including ships under construction, is made up as follows: Battleships, 11, including 2 under construction; first-class armored cruisers, 3, including one under construction; second-class cruisers, 2; third-class cruisers, 6; torpedo-avisos, 7; first-class torpedo-boats, 24; second-class torpedo-boats, 38. River monitors, 6, including 2 under construction; river patrol vessels, 7. Special service ships.—Casemate ships for local defence, 5; yachts and station-ships, 5; sea-going

factory-ship, 1; torpedo depot-ship, 1; submarine mining ship, 1; various duties, 12. Training-ships.—Sea-going training corvettes, 5; gunnery training-ships (including tenders), 4; torpedo training-ships, 2; submarine mining ship, 1, and two tenders; boys' training-ship, 1, with 2 tenders.—*U. S. Institution.*

The torpedo-boat flotilla of the Austrian navy is to be reconstructed, and in view of the discussions which have taken place as to the speed required for destroyers, the fact that the Austrians have fixed on 28 knots is interesting. This speed is to be attained when the vessels are carrying a load of 100 tons representing fuel and ammunition. The 25½-knot boats for the British Navy are required to carry 120 tons, and it is matter for serious consideration whether this justifies the decrease in speed of our vessels.—*Engineer.*

FRANCE.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
République	14,865	Brest.	Launched Sept., 1902.
Démocratie	14,865	"	" May 2, 1904.
Patrie	14,865	La Seyne.	" Dec. 17, 1902.
Justice	14,865	"	Building.
Vérité	14,865	Bordeaux	"
Liberté	14,865	St. Nazaire.	"
Armored Cruisers.			
Ernest Rénan	13,582	Brest.	Building
Jules Michelet	13,582	Lorient.	"
Jules Ferry	12,550	Cherbourg.	Launched Aug. 22, 1903.
Victor Hugo	12,550	Lorient	" March 30, 1904.
Léon Gambetta	12,550	Brest.	Under trial.
Sully	10,014	La Seyne.	" "
Dupetit Thouars	9,516	Toulon.	Launched July, 1901.
Edgard-Quinet	14,000	Brest.	Ordered.
C 17	14,000	....	Authorized.

The French navy estimates for this year total 310,000,000 fr. (£12,400,000). Of this sum 68,000,000 francs (£2,720,000) are to be devoted to the building and completion of iron-clads, a circumstance which M. Pelletan very much deplores. He asks Parliament to devote at least 23,000,000 francs (£920,000) to the construction of small craft.

Only one new armored cruiser is, however, included in the building program for 1905. She is to be of the Rénan type, and is known at present as C 17. She is to be built at Lorient, according to present arrangements. Four torpedo-boat destroyers of the Stylet class, of 28 knots speed, are also to be put in hand at Rochefort. For twenty torpedo boats the plans are not yet completed. With regard to submarine boats only very slight information is obtainable. At present there are twenty-three under construction, Omega at Toulon, Emeraud, Opale and Rubis at Cherbourg, and Saphir, Topaze and Turquoise at Toulon. These last six vessels were all commenced in October, 1903. They displace 422 tons, and are to have an indicated horse power of 600. Q 47—Q 62 are not yet laid down, while sixteen more, of the program of 1904, are to be built, four at Cherbourg and twelve at Toulon. The program for 1905 allows for eight more submarines, three to be built at Toulon, three at Cherbourg and two in Rochefort.

During 1905 there will be in all 95 vessels under construction for the French navy—six battleships, the République (to be commissioned during 1905), Démocratie, Patrie, Liberté, Justice and Vérité; four armored cruisers, Jules Michelet, Victor Hugo, Ernest Rénan and C 16 (C 17 being apparently indefinitely postponed); eight torpedo-boat destroyers—Stylet,

Tromblon, Pierrier, Obusier, Mortier, M 38 and M 39, to be built in the public yards, and Claymore in a private establishment; fifty-five torpedo boats—ten to be built in public and the others in private yards, and the twenty-three submarines above mentioned.

New regulations for the trials of vessels have been promulgated, and the first vessel to profit by them is the Condé. The tests are now arranged as follows: (1) Coal consumption trials of six hours' duration, with fires lighted under half the boilers; (2) two machinery trials, one of ten hours at full speed, and the other of three hours at the highest speed obtainable with three-quarters of the boilers in use; and (3) a run of twenty-four hours at ordinary speed. The time between the trials is not to exceed three days except under special circumstances, which must be reported to the Minister of Marine.

On her full speed trials the Condé attained a speed of 21.35 knots, with a maximum horse power of 22,800. The coal consumption was about 35.23 lbs. per square foot of grate surface. On the twenty-four hours' trial she did 18.6 knots with engines developing 11,000 horse power; the coal consumption working out at 1.63 lbs. per unit of power per hour. The whole of the trials were carried out in seven days, whereas under the old regulations they might have lasted weeks and even months.

The only other trial worth noting is that of the torpedo-boat destroyer Balliste. On a coal consumption trial, at a speed of 18 knots, she burnt fuel at the rate of 2.34 lbs. per unit of power per hour.—*Page's Magazine.*

THE NAVAL ESTIMATES FOR 1905.—The naval estimates demanded for next year, which have been laid before the Chamber of Deputies, amount to 318,068,813 francs (£12,722,752 10s.), as against 312,828,637 francs (£12,513,145 10s.) voted for the current year, showing an increase of 5,240,176 francs (£209,607).

The principal items are as follows:

	Proposed, 1905. Francs.	£	s.	Voted, 1904. £	s.
Ministry of Marine	3,519,451 =	(140,778	1)	140,778	1
Officers' pay	10,271,438	(410,857	10)	410,857	10
Men's pay	40,182,622	(1,607,304	18)	1,559,304	18
Ordnance staff	1,505,904	(60,236	4)	60,236	4
Construction	5,552,814	(222,112	12)	222,112	12
Naval Commissariat	1,136,094	(45,443	17)	64,947	1
Medical and religious staffs	1,825,344	(73,013	17)	73,013	17
Administration of the Inscription Maritime	3,416,611	(136,664	10)	136,664	10
Hospitals	2,326,441	(93,057	15)	93,057	15
Victualling	13,757,615	(550,304	14)	560,000	0
Transport service	4,442,000	(177,680	0)	142,400	0
Fisheries and commercial marine	1,092,799	(43,711	19)	41,711	19
Subvention to the Invalides de la Marine	12,050,000	(482,000	0)	472,981	8
Secret service	100,000	(4,000	0)	4,000	0
NEW CONSTRUCTION.					
Dock-yards.. Wages	11,948,000	(477,920	0)	481,362	8
Dock-yards.. Matériel	38,347,000	(1,533,880	0)	1,576,000	0
Dock-yards.. Miscel. expenses	12,975,629	(519,025	4)	530,372	17
Private yards	51,500,000	(2,060,000	0)	1,949,600	0
MAINTENANCE OF FLEET AND REPAIRS.					
Dock-yards.. Wages	5,103,000	(204,120	0)	200,674	12
Dock-yards.. Matériel	7,936,000	(317,440	0)	340,000	0
Private yards	1,000,000	(40,000	0)	40,000	0

ORDNANCE.				
New guns, repairs, etc.		18,158,150	(726,326 0)	693,980 16
Gunnery schools		5,330,000	(213,200 0)	216,800 0
Miscellaneous expenses		3,422,600	(136,904 0)	158,904 0
Torpedoes and electricity	Wages	677,274	(27,090 19)	27,090 19
	Matériel	4,095,500	(163,820 0)	163,820 0
	Miscellaneous	355,029	(14,201 3)	15,601 3
DOCK-YARDS AND NAVAL BASES.				
Improvement of plant (Bill 2d March, 1901)		2,840,000	(113,600 0)	113,600 0
Hydraulic works, etc.		2,990,373	(119,614 18)	121,067 5
Deepening of the Charente		250,000	(10,000 0)	10,000 0
Extraordinary expenditure on improvement of plant, etc. (Bill 2d March, 1901)		14,147,942	(565,917 15)	553,917 15
Do. hydraulic works, etc.		1,629,177	(65,167 2)	65,967 2

SUPPLEMENTARY ESTIMATES.—A supplementary vote for 9,581,200 francs (£383,248) has been submitted to the Chamber by the Ministry of Marine.

This credit is divided into two parts:

1. 1,479,200 francs (£59,168) for extra vessels commissioned to strengthen the French fleet in the Far East.

2. 8,872,000 francs (£354,880) for supplies of coal, munitions of war and extra accommodation at the *points d'appui*.

The following table shows the amounts expended on torpedo boats and submarines yearly, since 1895:

	Francs.	£ s.
1896	2,500,411 =	(100,016 10)
1897	4,293,922	(171,756 18)
1898	5,267,315	(210,692 13)
1899	8,526,341	(341,053 13)
1900	7,985,680	(319,427 4)
1901	11,723,433	(468,937 7)
1902	10,038,523	(401,540 18)
1903	10,132,219	(405,288 17)
1904	19,025,646	(761,025 19)
1905 (Budget)	22,900,476	(916,019 1)

PERSONNEL OF THE FLEET.—The following are the numbers of the officers of different ranks on the active list of the fleet: 15 vice-admirals, 30 rear-admirals, 125 captains, 215 commanders, 754 lieutenants, 420 sub-lieutenants, 170 midshipmen, and 67 cadets, making a total of 1796, of which number 1279 are actually serving at sea.

The engineer department consists of: 1 inspector-general, 6 engineer-inspectors, 20 engineers-in-chief, 100 chief engineers, 1st class, and 200 2d class, making a total of 327.

The medical branch consists of: 1 inspector-general, 5 directors, 30 doctors-in-chief, and 373 other medical officers of various grades.

The accountant department consists of: 1 commissary-general, 1st class; 3 commissary-generals, 2d class; 18 commissaries-in-chief, 1st and 2d class; 30 principal commissaries, and 136 other officers of various grades.

There are 82 chief warrant officers, 33,186 warrant and petty officers and seamen, 14,692 engine-room artificers, leading stokers and stokers, 386 armorers, 353 bandsmen and 1057 men for special duties, making a total of 49,756, showing an increase of 2003 over this year's effectives, which number 47,671.—*United Service Institution.*

The French Minister of Marine has given orders to the Forges et Chantiers Company, of Havre, to proceed with the construction of four floating docks for the use of torpedo-boat destroyers at Cherbourg, Toulon,

Bizerta and Saigon. The dimensions of these docks will be 164 feet long (with open ends) and of 41 feet width, capable of lifting vessels up to 360 tons.

France is entering upon a series of tests of submarine boats, primarily to determine whether the submersible or purely submarine type is the more satisfactory. The Aigrette is the representative of the submersible. She is a vessel of 172 tons displacement, and is propelled on the surface by an internal combustion motor, and when submerged by an electric motor. She is designed by Engineer Lauboeuf. The submarine boat is of 202 tons displacement, and always travels under the water. She is the design of Engineer Mangas. In her case, however, the speed is less than with a semi-submerged boat like the Aigrette. The crucial test, however, is that which concerns the time taken to disappear when there is reason to suppose that the enemy has discovered the presence of the submersible boat. In this respect the British boats of the Vickers type are specially satisfactory.

At the coaling of the French Mediterranean squadron at Toulon recently the length of time was taken and the quantities shipped by the various vessels were as follows: Marseillaise, 1040, in 8 hours 30 minutes; Suffren, 900 tons, in 8 hours 35 minutes; Iena, 800 tons, in 8 hours 15 minutes; Charlemagne, 650 tons, in 5 hours 45 minutes; Gaulois, 600 tons, in 4 hours 50 minutes; Saint Louis, 500 tons, in 5 hours; Bouvet, 370 tons, in 4 hours; Du Chayla, 300 tons, in 4 hours 50 minutes; Galilee, 300 tons, in 5 hours; and the Linois, 164 tons, in 1 hour 11 minutes, which was the largest quantity per hour.

In *Le Yacht* of July 9 we have a detailed account of the cruise of the Northern squadron along the French coast. As usual, special prominence was given to feigned attacks by submarines and submersibles. On Saturday, June 25, the submarines succeeded in accounting for the Jeanne d'Arc and Henry IV, while on Wednesday, the 29th, the submersibles attacked the squadron when approaching Cherbourg, and in two cases managed to get within easy striking distance undetected.

In commenting upon these attacks, the correspondent says, in conclusion, that there can be no longer any complaint of the want of proper training of the submarines. So far at least as those stationed at Cherbourg are concerned, it may be confidently stated that the crews are well trained and the officers full of zeal, so that, in spite of certain defects in matters of detail, submarines and submersibles may be counted upon to render important service in time of war, the first in the neighborhood of the port, the second further afield, anywhere, in fact, within a restricted area like the Channel.—*United Service Gazette.*

The *Yacht* describes the inspection made by Vice-Admiral Fournier of the French mobile defenses. The mobilization of the boats at Cherbourg was conducted in the best circumstances, and three hours after the order had been given the boats were ready for sea with all stores and necessaries on board. The submersibles Silure, Espadon, Sirène and Triton, and the submarines Français, Algérien and Morse distinguished themselves in their attacks on the armored gunboat Flamme, which served as a target for their torpedo. The correspondent who describes these exercises states that six first-class torpedo boats and two destroyers have been ordered at Havre. These are boats for retarding which the Minister has been reproached, but it is supposed that the delay will have enabled improvements to be effected in them. The torpedo boats will approach 100 tons in displacement, and are to steam at 26 knots with 2000 horse power, while the new destroyers will displace about 350 tons and are to be 30-knot boats with 7200 horse power. The Minister has appointed a committee to investigate

all questions relating to submarine navigation. It is well known that he has a preference for small submarine boats, and some of the papers anticipate that he will appoint a committee to enforce his views. Admiral Fournier has urged him to authorize the building of the submersible vessels ordered by his predecessor and afterwards countermanded.—*Army and Navy Gazette.*

The French Minister of Marine proposes to increase largely the number of engineer officers of the navy, and is about to present a *projet de loi* embodying his plans. The corps will consist of a chief engineer of the fleet or inspector-general of the first class, being a new appointment ranking with a vice-admiral, two inspectors-generals of the second class (rear-admirals), six chief inspectors of machinery (captains), 12 inspectors of machinery (frigate captains), 45 fleet engineers (corvette captains), 210 chief engineers (lieutenants), and 175 engineers (junior lieutenants). The establishment will differ from the existing one by the institution of the officer ranking as a vice-admiral, and the increase of the rear-admiral's rank, also by the creation of 12 inspectors of machinery, 25 new fleet engineers, 110 chief engineers, and 175 engineers. The number of additional officers will be 124, or about 30 per cent, and the increase will be wholly for service afloat, the shore establishment remaining the same.—*Army and Navy Gazette.*

The French Northern squadron has been engaged in very interesting exercises with torpedo boats and submarines. It left Brest on the morning of June 24, and on the next morning the three divisions united to the north of La Hague. At half-past ten the ships' companies were called to quarters to keep a sharp lookout for submarines. The Jeanne d'Arc and the Henri IV, however, were both torpedoed, but we have not learned from the *Yacht* any particulars as to whether the ships were actually under way at the time. At three o'clock the squadron anchored in Cherbourg harbor, where the submarines attacked at night. The sky was clear and the periscopes could be distinguished at a distance from about 400 to 500 meters. Torpedoes were fired with collapsible heads, but the result appears not to be known. The following day was given up to rest, and at six o'clock in the morning the squadron again put to sea in superb weather, and the same evening anchored at Boulogne, where it was attacked at night by the torpedo boats of the submarine defense of Dunkirk. The Cassini and Forbin, with the destroyers, were employed upon picket service, and the attacking boats were discovered at a considerable distance. On Tuesday, the 28th, the squadron left Boulogne for the north, and at five o'clock in the afternoon passed Folkestone and Dover, from which latter place it had to bear away because of the firing of the coast batteries. The same evening the Dunkirk torpedo boats attacked while the squadron was under way off Cape Grisnez, but they were discovered. The squadron had not yet done with the submarines, which on the night of the 29th attacked between Cape D'Ally and Saint Valery. The first submersible emerged at a short distance from the battleships, the second a little later, and the third between Fécamp and Cape D'Antifer, all within range, though no torpedoes appear to have been discharged. The last attack was delivered before the squadron reached Cherbourg, but no particulars have been published. The exercises were favored by excellent weather and a very calm sea. The correspondent of the *Yacht* remarks that there can be no complaint of failure in the readiness of the submarines, and that at least those at Cherbourg are in an excellent state of training. The crews are good and the officers full of zeal, so that, in spite of the imperfection of some details, it may be assumed that both submarines and submersibles would be of great value in war.—*Army and Navy Gazette.*

The Minister of Marine has decided that the additional station for submarines which was to have been established at Dunkirk, shall be at Calais

instead. The submarines will have the breadth of the English Channel as a field of action, and will, it is considered, be able to prevent warships approaching Dunkirk roadstead from the Channel. The eastern half of the French Channel coast will be under the protection of the Calais submarines.—*Engineer.*

Regulations of remarkable stringency are being drafted for service on board French submarines. The period for general service may be extended for two years for special service on submarines, but under conditions which may be relied upon to prevent supply running away with the demand. Officers of submarines are to have the right to transfer a petty officer or man back to the general service at the first symptom of any physical or professional failing. Every six months the crews of all submarine boats will undergo a special medical examination, and any physical affection, however, slight, will entail immediate exclusion from the submarine section.—*Engineer.*

GERMANY.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Braunschweig	13,200	Kiel.	Launched; complete in 1904.
Elsass	13,200	Dantzic.	" May 26, 1903.
Preussen	13,200	Stettin.	" Oct. 31, 1903.
Hessen	13,200	Kiel.	" Sept. 18, 1903.
Lothringen	13,200	Dantzic.	" May 27, 1904.
N	13,200	Gaarden.	Building.
O	13,200	....	"
P	13,200	Wilhelmshaven	"
Armored Cruisers.			
Prinz Adalbert	9,050	Kiel.	Under trial.
Roon	9,050	"	Launched June 27, 1903.
York	9,050	Hamburg.	" May 14, 1904.
F	9,050	Kiel.	Building.
Protected Cruisers.			
Undine	2,715	Kiel.	Under trial
Hamburg	3,000	Stettin.	" "
Bremen	3,000	Bremen.	" "
Berlin	3,000	"	Launched Sept. 22, 1903.
Munich	3,000	"	" April 30, 1904.
Lubeck	3,000	Stettin.	" March 30, 1904.

The new scheme for naval expansion which has been brewing in German official circles for some time past is rapidly coming to a head. From Berlin advices, thrown out perhaps semi-officially as feelers, it appears that this new scheme altogether surpasses the program of 1900. No fewer than twenty battleships and ten armored cruisers, together with attendant small craft, are said to be in contemplation. Germany is poorly supplied with torpedo craft, and the new program is expected to make liberal provision for this class of vessel, to the extent even of 6,925,000 marks (£346,250). Submarines are also to receive more attention than has hitherto been the case.

The Lothringen, battleship, was launched on May 27, at the Schichau Yard, Dantzic. The Lothringen was built ready for launching in exactly one year, and her launch leaves only one battleship now on the stocks, "N," which is building at Kiel. The boilers of the Lothringen are a combination of eight Schultz and six cylindrical boilers, and with engines developing 16,000 horse power and driving three screws. She is expected to attain a speed of 18 knots. Her other characteristics are similar to those of the other vessels of the Braunschweig class, already described in these notes.

The Berlin, protected cruiser, is expected to be ready for service next April, by which time the Hamburg should also be complete. At her full speed trials recently, the Hamburg developed under a forced draft 11,582 horse power, giving her a speed of 23.15 knots. On a mean of four runs over the measured mile, the results were 11,889 I. H. P., 145 revolutions and 22.54 knots.

The active list of the German navy for 1904 is composed of 1139 officers, ranking as follows: 5 admirals of the fleet, 7 vice-admirals, 17 rear-admirals, 6 post-captains, 136 captains, 273 commanders, 394 lieutenant-commanders, 245 lieutenants. There are also 470 sub-lieutenants and 151 naval cadets.—*Page's Magazine.*

The work of repairing and modernizing the four battleships of the Brandenburg class, which is being carried out at Wilhelmshaven, is so far advanced that the Wörth and Weissenburg will be ready for commissioning this autumn, when they will be attached to the second squadron of the active fleet. Among other improvements which have been carried out have been the substitution of steel, as far as possible, for wood; the removal of the torpedo-tubes to position below the water-line from the stations above water, where they were originally fitted, which has been a work of some difficulty; a complete overhaul of the engines and boilers, and the strengthening of the secondary battery amidships by an additional two 4.7-inch Q. F. guns. The other two ships of the group, the Kurfürst, Friedrich Wilhelm and the Brandenburg, will not be completed until next year.—*United Service Institution.*

The use of oil fuel is being extended in the German navy. Several of the torpedo boats in addition to some of the larger ships are now fitted to consume oil. The Imperial yacht Hohenzollern is so fitted, while all the new battleships of the Braunschweig type carry 200 tons of oil in their double bottoms. Large tanks have been erected in the dock-yards at Kiel and Wilhelmshaven, and at the coaling stations at Holtenau and Brunsbüttel for the storage of oil, while an oil transport-ship has recently been delivered at the Imperial dock-yard at Kiel specially built and fitted for replenishing the oil supplies in ships at sea or in harbor. The vessel is divided into twelve large water-tight compartments, besides being built with a double bottom; six of these compartments are used for the storage of oil, while in the after part of the ship is a powerful pumping equipment for supplying the oil to other ships, and a steam heating apparatus for maintaining it at a proper temperature.—*United Service Institution.*

The *Danziger Allgemeine Zeitung* states that the question is being considered of giving a stronger armament to German torpedo-boats in the shape of guns of larger caliber. At present the torpedo-boats of 400 tons carry only three 1.97-inch guns. In the English, French, Russian, and Japanese boats the guns are heavier, though the craft are for the most part smaller. The English boat of from 300 to 400 tons carries one 3-inch and five 2¼-inch guns, and that of 240 tons one 3-inch and three 2¼-inch guns. Japan, as in most things naval, follows England's example. France gives her 335-ton boat one 2.56-inch and six 1.85-inch guns. Russia's sea-going boats have each one 2.95-inch and five 1.85-inch guns. Only the United States is in agreement with Germany in this matter, and, after all, the weapon of a torpedo-boat is the torpedo.—*U. S. Gazette.*

A Berlin correspondent telegraphs: "An important change is about to be introduced in the torpedo-tubes used in the German navy. For a long time the need of submerged tubes capable of being trained in any direction, like a gun, has been felt. The difficulties connected with the construction of such tubes have at last been overcome, and the torpedo boat Schwaben will shortly be equipped with the first set. It is stated that,

owing to the inferior armament of German torpedo boats as compared with those of other nations, the question of arming them with heavier guns will shortly be considered."—*United Service Gazette.*

In addition to the vessels of the active fleet the following will take part in the grand German naval maneuvers: From September 4 to 10—The battleship Schwaben, the large cruiser Prinz Adalbert, the small cruiser Pellican, the training ships Olga and Carola, and two torpedo boats. From September 4 to 13—The small cruisers Nymphe and Hamburg. The German Emperor will be on board the battleship Kaiser Wilhelm II, and will probably command in person. Superior officers of the German army to the number of fifty will be distributed on board the various warships in order to watch the maneuvers, which will include landing operations. Among them will be a large proportion of artillery officers.—*United Service Gazette.*

GREAT BRITAIN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Lord Nelson	16,500	....	To be begun in 1904.
Agamemnon	16,500	....	" "
Africa	16,350	Chatham	Building.
Britannia	16,350	Portsmouth.	"
Hibernia	16,350	Devonport.	"
Hindostan	16,350	Clydebank.	Launched Dec. 18, 1903.
New Zealand	16,350	Portsmouth.	" Feb. 4, 1904.
Commonwealth	16,350	Glasgow.	Under trial.
Dominion	16,350	London.	Launched Aug. 25, 1903.
King Edward VII	16,350	Devonport.	" July 23, 1903.
Queen	15,000	"	Under trial.
Armored Cruisers.			
Minotaur	14,600	....	
Shannon	14,600	....	
Defence	14,600	....	
Orion	14,600	....	
Duke of Edinburgh	13,500	Pembroke.	Launched June 14, 1904.
Black Prince	13,500	Blackwall.	Building.
Warrior	13,500	Pembroke.	"
Cochrane	13,500	Glasgow.	Ordered.
Natal	13,500	Barrow.	"
Achilles	13,500	Newcastle.	"
Hampshire	10,700	Elswick.	Launched Sept. 24, 1903.
Devonshire	10,700	Chatham.	" April 30, 1904.
Roxburgh	10,700	Glasgow.	" Jan. 19, 1904.
Antrim	10,700	Clydebank.	" Oct. 8, 1903.
Argyll	10,700	Greenock.	" March 3, 1904.
Carnarvon	10,700	Glasgow.	" Oct. 7, 1903.
Cornwall	9,800	Pembroke.	Under trial.
Lancaster	9,800	Elswick.	"
Protected Cruisers.			
Encounter	5,880	Devonport.	Launched June, 1903.
Topaz	3,000	Birkenhead (Laird).	Under trial.
Amethyst	3,000	Elswick (Armstrong).	Launched Nov. 5, 1903.
Diamond	3,000	Birkenhead (Laird).	" Jan. 6, 1904.
Sapphire	3,000	Yarrow (Palmer)	" March 17, 1904.
Gunboats.			
Cadmus	1,096	Sheerness.	Launched April 29, 1903.
Clio	1,096	"	Under trial.

VESSELS BUILDING—*Continued.*

Name.	Displacement.	Where Building.	Remarks.
Scouts.			
Adventure	2,750	Elswick.	Building.
Forward	2,545	Fairfield.	Launched Aug. 27, 1904.
Pathfinder	2,610	Birkenhead.	Launched July 16, 1904.
Sentinel	2,900	Vickers.	" April 19, 1904.
Skirmisher	2,900	"	Building.
Foresight	2,545	Fairfield.	"
Attentive	2,750	Elswick.	"
Patrol	2,610	Birkenhead.	"

During the discussion on the shipbuilding vote on August 4 the following information was given by Mr. Pretyman on the subject of the design of the new battleships and cruisers shortly to be put out to contract. The battleship class will be known as the Lord Nelson class, and two ships of the class are to be laid down in private yards this year, the name ship and the Agamemnon. They are to be vessels of 16,500 tons, will carry four 12-inch and ten 9.2-inch guns, the former having a command forward of 37 feet and aft of 32 feet, the latter having a command of 22 feet, and their engines will develop about 16,500 horse power, giving a maximum speed of 18 knots, with a continuous sea speed of 16¼ knots. They will ordinarily carry 900 tons of coal, with a maximum of 2000 tons. They will have 12-inch armor amidships, 8-inch on the upper deck, 6-inch forward and 4-inch aft. The total cost will be about £7000 more than that of the King Edward VII. The cruisers are to be known as Minotaur, Shannon, Defence and Orion. They are to displace 14,600 tons, and carry four 9.2-inch guns and ten 7.5-inch guns each. Their maximum speed is to be 23 knots, with a continuous sea speed of 21 knots. The guns are to be well protected behind 8-inch armor. The battleship will be slightly larger than those of the King Edward class, and the cruisers will not be so long as the Drakes. In armament and general power they are expected to be an advance on anything yet constructed in battleships or first-class cruisers.—*Army and Navy Gazette.*

The designs of the new battleships of the Nelson class are now in an advanced stage, and the invitations to shipbuilders to submit tenders will be issued towards the end of August or beginning of September. Their chief characteristic will be the great gun power. There will not be any reduction of freeboard, as has been intimated. This would have been a serious departure from what is regarded now as a first essential to successful fighting in a seaway. The monitor class may have the advantage of a small target, and may minimize the weight of the armor protecting the broadside; but there is the overbalancing disadvantage that the placing of the guns so near the water-line would cause the muzzle to be water-covered when the ship rolled towards a wave, making rapid fire and accuracy impossible. The tendency rather is to insure a high gun platform, and thus in the new Nelson class there will be no guns on the main deck, as in our earlier ships; all of them will be on the upper deck.

The guns of the new vessels, too, will be more powerful. There will be two barbettes—one forward and the other aft—and in each there will be two 12-inch breech-loaders. This is the same as in all our modern battleships. The secondary armament will consist entirely of 9.2-inch guns. In the King Edward VII class there are four of these guns, in addition to ten 6-inch quick-firers; but in earlier ships there were twelve or fourteen 6-inch guns only. But according to present intentions there will be in the Nelson class ten 9.2-inch guns, which will make them by far the most powerful ships afloat. Twin 9.2-inch guns will be mounted in turrets at the four quarters of the citadel, and a single gun in the center on each side. These guns will be built into the upper deck, which is to be heavily armored, the mechanism and mounting being protected by armored hoods or turrets. Thus the broadside of 9-inch Krupp armor will be utilized for

protection from broadside attack, and the main amored bulkheads forward and aft for shielding the gun mountings from raking fire. The broadside armor will, therefore, not be weakened by openings, and at the same time the lower parts of the gun mountings and ammunition hoists will be effectively protected.—*United Service Gazette.*

The more the new battleships and cruisers of the Lord Nelson and Minotaur classes are discussed, the more evident it becomes that both types of vessels are far ahead of anything that has yet been designed. It is almost a misnomer to describe the Minotaur class as armored cruisers, for they are in many respects superior to battleships in our own and other navies which have been designated "first-class." Comparison of gun power alone is, as many authorities have pointed out, misleading, but it is mainly in gun power that we find the overwhelming superiority of these new vessels. They transcend the vessels of all other navies in this respect, and the design which comes nearest to them is that of the American Kansas class. The principal armament of the Lord Nelson, the 12-inch 45-caliber gun, will, it is calculated, pierce 12-inch Krupp steel at 4000 yards, while the 50-caliber 9.2-inch gun of the secondary battery is superior in penetrative power to the 12-inch guns of the Majestic class. Added to this the fact that with a well-trained gun's crew these pieces can fire three shots a minute, it becomes evident that no ship at present afloat is in the same category as the Lord Nelson. This is as it should be, of course, but we have yet to see what other nations will build. The loss of half a knot speed is more than compensated for by the immense offensive power gained, and the fact that the armored cruisers which ought to form a second division have all the speed necessary for a long running fight.

The cruisers mark, as do the battleships, a noteworthy advance on their precursors. They are larger than any other vessels of their class yet designed, their nearest rivals being, as in the case of the battleships, the cruisers building by the Americans, of the Tennessee class of 14,500 tons. These vessels will be about equal in gun power, but much inferior in protection, to the Minotaur class. Factors of very great importance in cruisers are, of course, speed and coal capacity. The Minotaurs are not in these respects equal to the Drakes, or to the Ernest Renan class of the French navy. But in coal capacity they will surpass the Tennessee class, and their twenty-three knots speed, if they can attain it, should be adequate. Previous experience with large cruisers in our navy has led us to expect them to exceed rather than fall short of their designed speed, and if the Minotaurs do this they will be the most formidable armored cruisers afloat. We have heard much of the power of the vessels of the German navy, but in this class they have nothing to approach our vessels. The Roon, armed with 8.2-inch and 5.9-inch guns, and with a belt of 4-inch armor, fine ship though she is in many respects, would be helpless against the Minotaur, and the Ernest Renan has neither the offensive nor defensive powers of the British ship.—*Army and Navy Gazette.*

The Monmouth, of the County class, which recently experienced some trouble with her condensers, has made the trip from Gibraltar to Plymouth in 53 hours 7 minutes, which gives an average speed of 20.5 knots. Whatever may be said against the County class, the old reproach about their steaming capabilities is now very out of date. Her engines and boilers were constructed by the London and Glasgow Shipbuilding Company. The engines are of the four-cylinder vertical triple-expansion type, and the boilers of the Belleville variety. The long distance cruise from Gibraltar to Plymouth is nowadays thought a good deal more of than the relatively short full power trial, and we congratulate her builders upon the record that they have obtained in a ship that was supposed to be under a cloud. The case is yet another instance of the advisability of taking stories of failures that appear in the daily press with a good supply of salt.—*Engineer.*

The Repulse, battleship, arrived on July 23 at Sheerness, and went on to Chatham, where she will be completed for transfer to the A division of the Fleet Reserve. In addition to a thorough overhaul of her machinery and the making good of structural defects the vessel has been fitted with six new 6-inch guns, which necessitated various alterations to the ship. The steam trials were of a severe character, the machinery having to develop and maintain the original maximum indicated horse power (9000) for eight hours. No difficulty was experienced in doing this, the average I. H. P. for the full time being about 9100, while a speed of 15½ knots was obtained. The trials of the gun mountings were also satisfactory. The Repulse is to be ready for passing into the Fleet Reserve towards the end of August.—*United Service Gazette.*

H. M. S. Pathfinder, the first of the two fleet scouts now building by Messrs. Cammell, Laird & Co., Limited, was launched on July 16 at the shipbuilding works of the company at Birkenhead. The scouts, of which this vessel is one, are designed to be the fastest sea-going vessels in the world, and it is expected that 25 knots will be obtained on a prolonged full power trial. The following are the principal dimensions of the vessel: Length, 370 feet; beam, 38 feet 6 inches. She will be propelled by two sets of four-cylinder triple-expansion engines of 16,500 horse power, balanced on the Yarrow, Schlick and Tweedy system, steam being supplied by twelve water-tube boilers of the Laird type, arranged in three water-tight compartments. A protective deck is worked throughout the ship. The engines are protected by 2-inch specially treated Krupp non-cemented steel made at the company's armor-plate works at Sheffield. The armament consists of ten 12-pounder quick-firing guns mounted as follows: Three on forecastle deck, three aft on upper deck, four on upper deck in waist of ship. Also eight 3-pounder quick-firing guns and two 18-inch torpedo-tubes above water. When in commission the vessel will have a complement of about 290 men. H. M. S. Patrol, the second vessel of this type now building by the firm, is also in an advanced stage of construction.—*Engineer.*

An interesting Parliamentary return has been issued at the instance of Mr. Kearley, M. P., in connection with the trials of the new destroyers of 25½ knot speed, which indicates under what severe pressure the speed is realized by these larger craft. They are on an average 230 tons heavier than the earlier boats of 30 knot speed, ranging up to 550 tons. Their construction was decided upon as a result of strictures made on the strength of the lighter boats by the court-martial which sat in judgment on the loss of the Cobra. Events, however, have proved that these criticisms by officers, who were not versed in naval architecture or in the problems of stresses of sea-going craft, were not justified, and the committee of experts appointed to make thorough and scientific investigation of the subject came to the definite conclusion that there was no reason for the alarmist attitude taken. Larger boats no doubt have their compensations, but without increasing the gun power they cost 25 per cent more and reduce materially the radius of action at any given speed. Moreover, events in the Far East have shown that speed is everything in destroyer tactics, so that the reduction from 30 to 25½ knots is a serious matter, especially as the lower sped is difficult of realization. In the old days a ship was not expected to require more than 1 inch or 1¼ inches of forced draft in the closed stokehold, although in some extreme cases this has been considerably exceeded. With these destroyers, however, the pressure was under 2 inches in only three cases out of seventeen trials completed, while in the other it ranged up to 5.3 inches, in two cases it was 4.4 inches, and in the others it ranged between 2½ and 3 inches. The Yarrow boats seems to have done best in this respect. Two of the boats are turbine-driven, and one, the Velox, steamed 27.1 knots for 7.35 tons of coal per hour; the other, the Eden, 26.2 knots for 7.45 tons

per hour. The best result with reciprocating engines was 26.2 knots with a coal consumption of about 5½ tons per hour, this vessel having the remarkably low rate of 1.65 lbs. per I. H. P. per hour. Another reciprocating-engined vessel returned 1.56 lbs. for 25.8 knots, which also gives a better result than the turbine vessels. A third, which steamed 26.1 knots, only consumed 1.9 lbs. All these three vessels were Yarrow boats. In the case of the other vessels the consumption ranged up to 2.79 lbs., so that the average result is not more than the 7 1-3 tons recorded for the turbine vessels. Where the consumption was over 2½ lbs., the vessel had to carry an increase in load at the rate of four tons for each tenth of a pound in excess of 2.5 lbs. per I. H. P. per hour, while for less consumption a deduction was made for the saving on the same basis.

The return itself is as follows:

DESTROYERS BUILT AND LAUNCHED SINCE JANUARY 1, 1902, FOR HIS MAJESTY'S NAVY.

Name of Destroyers.	By whom Built.	Speed obtained on Full-Speed Trials. Knots.	Consumption of Coal per Horse-Power on the High-Speed Consumption Trials.	Average Air Pressure in the Stokehole on the Full-Speed Trial.
Velox (turbine)	Hawthorn, Leslie	27.1	7.35 tons per hour total	3.1
Erne	Palmer's Company	25.6	2.25	2.5
Derwent	Hawthorn, Leslie	25.7	2.24	2.8
Foyle	Laird Brothers	25.6	2.79	4.4
Ettrick	Palmer's Company	25.6	2.33	2.6
Eden (turbine)	Hawthorn, Leslie	26.2	7.45 tons per hour total	3.3
Waveney	Hawthorn, Leslie	25.6	2.19	3.2
Itchen	Laird Brothers	25.6	2.46	4.3
Exe	Palmer's Company	25.6	2.11	2.4
Arun	Laird Brothers	25.7	2.68	4.4
Cherwell	Palmer's Company	25.6	2.34	2.7
Usk	Yarrow and Co	26.1	1.9	1.6
Blackwater	Laird Brothers	25.7	2.62	5.3
Dee	Palmer's Company	25.5	2.28	2.6
Teviot	Yarrow and Co	25.9	2.07	2.0
Kennet	Thornycroft	Trials not yet carried out		
Jed	Thornycroft			
Ribble	Yarrow and Co	25.8	1.57	1.6
Welland	Yarrow and Co	26.2	1.65	1.8

—*United Service Gazette.*

Details have just been received concerning the loss of the destroyer Sparrowhawk on the China station. On the night of Friday, June 17, she struck an uncharted rock northeast of Chesney Island, one of the Parker group. The flagship Glory and the destroyer Fame stood by her all night, and so hard did all hands work under the superintendence of Flag-Captain the Hon. W. G. Stopford, that she was towed off on the Saturday morning and brought alongside the Glory. Subsequently she sank in eight fathoms. The rock pierced her hull abaft the third funnel, and after being towed off it is supposed that her engine-room bulkhead gave way, causing her to snap in two. All her guns, torpedoes, ammunition, spars and loose gear were saved, and no lives were lost. Fortunately, only her forward furnaces were going when she sank, otherwise she might have blown to pieces.—*United Service Gazette.*

The new Exe class destroyers now building are fourteen in number and named as follows: Thornycroft boats—Chelmer, Colne; Yarrow boats—Gala, Garry; Hawthorn Leslie boats—Kale, Doon, Boyne; Laird boats—Moy, Ouse; Palmer boats—Ure, Wear; White boats—Ness, Nith. The fifteen boats projected for the 1904-05 program have not yet been named or commenced.—*Engineer.*

The first-class armored cruiser Duke of Edinburgh, which was launched on June 14, is the first of the new class to take the water, the remaining five being the Black Prince, Achilles, Natal, Warrior and Cochrane. These cruisers represent a type which has been evolved as the result of experience gained with a succession of armored cruisers, commencing with the Drake and Cressy classes, and passing on to the Monmouth and the improved Monmouth, or Devonshire type. The weakness of all the vessels named consisted chiefly in the adoption of the 6-inch B. L. gun as the preponderating arm. In the Duke of Edinburgh the 6-inch gun is retained on the main deck, but her design provides for six 9.2-inch guns to be mounted in barbettes on the upper deck; one forward, one aft and two on each broadside. This powerful armament, and the fact that these vessels will be the first cruisers to have a complete armor water-line belt, are the most important distinctive feature of the Duke of Edinburgh and her sisters. The remaining armament will comprise twenty-four 3-pounder Q. F. guns, with four machine guns. The full armament of the ship will therefore be six 9.2-inch B. L., six 6-inch B. L., and twenty-eight smaller guns. This represents an enormous increase in offensive power over that possessed by any previous cruiser. In this connection, also, she is possessed of a new feature in the shape of a center line submerged torpedo tube. Years ago it was customary to fit stern tubes above water, but they were abandoned because of difficulties experienced in directing the torpedoes. Latterly, however, a new invention has removed that difficulty, and hence the Duke of Edinburgh is to be fitted with a stern submerged tube. She will also have one submerged tube on each side near the bow. All three will discharge 18-inch torpedoes.

It is reported that in the four last laid down vessels of this class, the Achilles, Natal, Cochrane and Warrior, the ten 6-inch guns on the main deck are to be done away with, and four additional 9.2-inch will take their place on the upper deck, but this seems doubtful.

The principal dimensions of the Duke of Edinburgh are: Length, 480 feet; extreme beam, 73 feet 6 inches; mean draft as designed, 27 feet (her actual draft when complete will probably be about 9 inches more); displacement, 13,550 tons. The estimated weight of the hull, when complete, is 8015 tons. There is a complete armor water-line belt 6 inches thick amidships, tapering to 4 inches forward and 3 inches aft; the 3-inch and 4-inch armor extends only from the lower to the main deck, but the 6-inch will be carried to the upper deck, and superimposed on the main deck at the points forward and aft where the 6-inch armor terminates. Athwartships, armor bulkheads 6 inches thick will be fitted between the main and upper decks, which, with the side armor, will form a central citadel. The lower deck of the ship is curved downwards towards the sides, forming an arch throughout. It is built of two thicknesses of ⅜-inch plating. The main deck within the citadel is formed of a single thickness, but outside at both ends it is worked in two thicknesses of ½-inch plating for protective purposes. The upper deck over the citadel is built of two thicknesses of ⅝-inch plate, but beyond it towards both ends it is worked in single thickness. The plating of the top sides, where there is no armor and aft, is 7-16 inch thick.

Above the upper deck, terminating at about the same point as the thick side-armor, a superstructure will be erected, which will be carried forward to form a boat deck. A similar superstructure will be erected above the forecastle also, at about the point where the thick side-armor

terminates forward. Twenty of the 3-pounder guns will be mounted on these superstructures, ten forward and ten aft. Along the sides, but at some distance from them, hammock berthings will be built, thus connecting the aftermost superstructure with the forecastle. On the upper deck abaft the superstructure, and on the forecastle immediately before it, the barbettes for two of the 9.2-inch guns formed of 6-inch armor, and built on a strong substructure, erected upwards from the lower deck, in each of which one 9.2-inch gun will be mounted, will be constructed. These guns will have an arc of fire of 270 degrees. At the four corners of the central citadel on the upper deck similar barbettes will be constructed, and in each of these the other 9.2-inch guns will be mounted. The aftermost of these guns on both sides will fire 2 degrees across a fore and aft line, and, in order to permit this, the top side plating above the main deck has been recessed back to form a lengthy embrasure. Beneath these corner 9.2-inch guns 6-inch guns will be mounted on the main deck, and the two after ones will have a similar range to the larger guns above them. Between the foremost and aftermost 6-inch guns, at equal distances along both sides, three other 6-inch guns will be mounted, all at ports, and all having a range of 120 degrees.

The interior of the ship is divided into compartments on much the same lines as other ships. The boiler and engine rooms occupy the middle part below the lower deck, and the magazines, shell rooms and store rooms are at the extremities. The lower coal bunkers skirt the boilers rooms along the sides, and the ammunition passages, which afford communication with the principal magazines and shell rooms, and the tubes through which the ammunition is passed to the fighting positions, occupy the inner upper corner of the coal bunkers on both sides. Three passages contain a novel feature. Immediately under each of the broadside guns, magazines and shell rooms to contain ammunition for "ready use" are to be constructed. These compartments will considerably reduce the coal capacity of the bunkers, but this point is apparently considered of comparatively little importance, as the inter-bottom spaces on both sides throughout the entire length of the boiler rooms and below the second longitudinal have been constructed to carry oil fuel. The coal capacity of the ship is estimated at 1000 tons.

On the main deck, aft, the officers' cabins and the wardroom will be situated; in the middle part, the central citadel, in which the 6-inch gun positions will be separated by 2-inch splinter bulkheads, and forward, a portion of the crew will be accommodated, the remainder being located on the upper deck in the forecastle.

The ship will have two masts and four funnels. She will be lighted throughout with electricity and ventilated by electrically driven fans, distributing air through a system of pipes.—*United Service Institution.*

Much interest has been aroused by the decision to add to the gun power of armored cruisers on the stocks. In the Devonshire and her sisters the four forward 6-inch guns will be replaced by a pair of 7.5-inch Q. F. carried on the upper deck. In the four later ships of the Black Prince class, viz., the Warrior and her sisters, the ten 6-inch Q. F. will be replaced by four 7.5-inch Q. F. on the upper deck. All these guns will be protected. The Black Prince and Duke of Edinburgh are so far advanced that the cost of the change has become prohibitive.

The standard for the reserve of guns has been placed at one 9.2-inch per ship armed with that piece, one 7.5-inch per four guns in service, and one 6-inch per five guns in service.

At the end of the financial year an unusually extensive renaming of old ships took place, with the laudable object of making some of the old names available for new ships. Names thus set free include Adventure, Black Prince, Espiègle, Hibernia, Mutine, Perseus, Swiftsure, Triumph, and Warrior, all of which had been conferred by anticipation on modern

ships. Agincourt, Audacious, Bellerophon, Invincible, Marlborough, Minotaur, Monarch, Northumberland, Temeraire, all of which names bulk largely in our naval history, are available for ships still to be built.—*Royal Navy List.*

From a reply by Mr. Pretyman to Sir Charles Dilke in the House of Commons it appears that in the boiler committee experiments the coal consumption with Babcock and Belleville boilers was equal, averaging 2 lbs. per indicated horse power. With Yarrow boilers the average was .1 lb. more. This works out to about a ton an hour in a ship of the County class, doing full speed, or 168 tons a week, supposing the ship able to steam at full power for so long. Fortunately perhaps eight hours or so is as much full speed as is likely to be demanded from any ship except in the stress of war.—*Engineer.*

The trials of the Commonwealth in the Clyde have now been completed, and the published results are very satisfactory. On June 21 she began her thirty hours' one-fifth power trial, and completed it on the afternoon of the 22d. She made a speed of 11 knots, with engines developing 3644 horse power and 70.6 revolutions per minute. The consumption of coal averaged 1.74 lbs. per horse power per hour. The thirty hours' three-fourths power trial was begun the same evening, and resulted as follows: Speed, 17.9 knots; I. H. P., 12,769; revolutions, 107.4; the coal consumption working out at 1.68 lbs. per horse power per hour. The full power trial took place on June 25, and on six runs on the measured mile the vessel attained a speed of 19.01 knots, the indicated horse power totalling 18,358, and the revolutions 120. The Commonwealth was built to attain a speed of 18.5 knots with 18,000 horse power, and the results attained, therefore, reflect great credit on the builders. The auxiliary machinery trials, anchor, circle-turning and steering trials were all carried out in one afternoon, and the whole of the trials of the vessel were therefore completed in a week, a remarkably good record.—*Army and Navy Gazette.*

The new floating coal depot arrived at Portsmouth on Monday from the Tyne. It is a huge steel-built hull, capable of holding 12,000 tons of coal, but as all the upper works have yet to be built it will be some months before the vessel will be ready for service. Moorings for this floating depot are being prepared well up the harbor, and battleships and cruisers will be easily able to lie alongside for coaling. There will be eight towers on the depot, each having its own Temperley transporters for lifting coal bags on to the decks of warships. The depot will supply a long-felt want.—*United Service Gazette.*

THE NAVAL ENGINEERING COLLEGE.—We have already said a good deal about the new system of education introduced by the Admiralty and the Training College at Devonport. It appears now that more accommodation has been provided than is for the time being necessary, and the Admiralty have very wisely determined to utilize it by taking students who will not necessarily enter the navy. A circular has just been issued by the Admiralty, from which we learn that arrangements have been made for the entry of a limited number of supplementary cadets as private students over and above the number of cadets entered for the service. Students so admitted will have the same advantages as the ordinary engineer and constructor cadets in respect both of the college residence and training and of practical work in the dock-yard, without being under any obligation to enter his Majesty's service at the end of their period of training. The course of training taken by the students will be the same as that laid down for engineer cadets or cadets of naval construction, and will last for the same period, but it will be open to them to withdraw at any time. It must be understood that the Admiralty have nothing to do with the subsequent

career of these cadets, but, should vacancies occur, exceptional facilities will be given them for competition. The annual cost to parents and guardians will be £75 per annum, to cover board and residence, tuition and practical instruction in the dock-yard. Application should be made before the 7th instant for admission. Detailed information can be obtained from the Secretary to the Admiralty, Whitehall.—*Engineer.*

The following maneuvers and exercises will be carried out in home waters:

Torpedo Craft Maneuvers.—"A," Blue Side.—The commander-in-chief of the Home fleet, Vice-Admiral Sir A. Wilson, will be in chief command, the torpedo craft being under the immediate command of Captain E. F. B. Charlton, the officer in charge of the Home fleet destroyers. The composition of the force will be six torpedo gunboats, 48 destroyers, three torpedo depot ships. Territory: north, east and south coast of Ireland, with Carrickfergus, Waterford and Queenstown as bases.

"B," Red Side (Rear-Admiral C. G. Robinson in chief command, with the cruiser Highflyer as his flagship).—The composition of the force will be 11 torpedo gunboats, 27 destroyers (17 acting as torpedo boats with reduced speed), 38 torpedo boats, all submarines, three torpedo depot ships, two submarine depot ships. Territory: west coast of Great Britain, with Loch Ryan, Milford Haven and Falmouth as bases. Chief umpire, Rear-Admiral H. T. Grenfell, C. M. G.; umpires: 12 captains and commanders, including five officers from the Naval Intelligence Department.

The above named vessels were either specially commissioned or completed to full complements on Wednesday, and after preliminary exercises will carry out maneuvers in the Irish Channel between August 8 and 15. During the latter period certain battleships and cruisers will take part.

Fleet Exercises.—The Home fleet and Channel fleet will each have its normal battleship strength of eight brought up to twelve by the addition of battleships in reserve, which will be specially commissioned on Monday. An additional rear-admiral will also be appointed to each fleet. The six sea-going Royal Naval Reserve drill ships will join the Home fleet, and the Cruiser squadron will join the Channel fleet on the same day. This total force of twenty-four battleships and twenty cruisers will carry out a series of fleet exercises until August 15.—*Army and Navy Gazette.*

It is evident from the official statement in connection with the torpedo craft maneuvers that they will not differ exceedingly from those of last year, which were carried out in the same waters. The composition of the flotillas does not show a striking difference, save in one respect, the addition of *all* the submarines with their depot ships. It may be permitted to us to doubt, however, whether there can be any resemblance to actual warfare in such maneuvers as are permitted to submarines. For purposes of comparison the figures are appended:

BLUE SIDE.

	1903.	1904.
Torpedo gunboats	5	6
Destroyers	37	48
Depot ships	4	3
Cruisers	2	0
Gun vessels	2	0

RED SIDE.

	1903.	1904.
Torpedo gunboats	10	11
Destroyers	0	10
Destroyers acting as torpedo boats	24	17
Torpedo boats	37	38
Submarines	0	6
Depot ships	4	5

The area of hostilities is the same as in 1903, but the bases differ slightly. Then there were four bases on the Blue side, now only three—Carrickfergus, Waterford and Queenstown—while the north, east and south coast of Ireland is the territory of this force, and Lundy Island is omitted. On the Red side the territory comprises the west coast of Great Britain, with Loch Ryan, Milford Haven and Falmouth as bases. It will be noted that Holyhead has disappeared on this side, as Kingstown has on the other, and that Falmouth takes the place of the Scilly Isles. The strength of the umpire staff has been increased from one rear-admiral, two captains and one commander, to one rear-admiral and twelve captains and commanders, including five officers from the Naval Intelligence Department.—*Army and Navy Gazette.*

The torpedo craft maneuvers, as they are somewhat quaintly entitled by the authorities, began on August 8, to extend over a period of seven days. The area of operations and the composition of the forces on either side have already been described in these columns. No official program was issued, but the correspondents at the headquarters were informed that the purpose of the maneuvers is "to ascertain as far as possible the extent of the dangers which threaten a fleet compelled by strategic exigencies to move within the radius of action of strong hostile torpedo craft flotillas, but having the advantage of a superiority of force over the enemy in battleships and cruisers, and the support of equally strong torpedo craft flotillas of its own." In order to test the matter, the Blue side was provided with a squadron composed of four battleships and two cruisers, which put to sea from Mount's Bay on August 6, and kept out of sight of land until eight o'clock on the morning of the 8th, when war was declared. Then the squadron approached the English coast until it could be seen by the red signallers, when it shaped course for Milford Haven. South of the port it was met by a flotilla of Blue destroyers, and guarded past the hostile base. Then, proceeding northwards, it reached Carrickfergus, in Belfast Lough, at noon on August 9. At a late hour the same night the squadron weighed, and, again escorted by another destroyer flotilla, it passed safely through the narrow channed opposite Loch Ryan, and arrived at its northernmost base on August 10, thus having achieved the passage in safety.

Practically this result was due to the tactics of the Blue side in setting up a blockade of the principal Red port. The Blue destroyers from Queenstown, as soon as they had communicated with the battle squadron, ranged themselves in front of the entrance to the haven at Milford, in order to intercept any of the enemy's vessels that might emerge. In order to raise this blockade some of the Red gunboats which had been sent into the Bristol Channel were summoned back, and at the same time a flotilla was dispatched from the port. A battle ensued, in which the Blues were driven off, losing three destroyers, the Thorn, Ostrich and Quail, while the Reds lost a gunboat, the Seagull, and a submarine of the Holland type. Two other Blue boats were placed *hors de combat*, the Tiger and the Contest, but this was due to a collision, and not to the efforts of the enemy. Another engagement took place in the North Channel, where the Carrickfergus Blue flotilla and the Loch Ryan Red flotilla came into contact, with the result that the Blues suffered the loss of three destroyers, the Havock, the Salmon and the Usk. Here also, owing to a collision, two Red boats were put out of action, Nos. 82 and 86. On the whole, therefore, the first phase of the operations must be said to have been decided in favor of the Blues, who, with the loss of six destroyers, were able to protect their battle squadron during its transit of the area of hostilities. With the second half of the maneuvers we must deal next week.—*Army and Navy Gazette.*

JAPAN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Kashima	16,500	Vickers.	Building.
Katori	16,500	Armstrong.	"
Armored Cruisers.			
1, 2, 3,	9,900	.....	Projected.
Protected Cruisers.			
3, 4	5,000	.....	Projected
Nitaka	3,470	Yokosuka	Launched
Tsushima	3,470	Kure.	"
Otawa	3,000	Yokosuka.	"

Through the courtesy of Sir W. G. Armstrong, Whitworth & Co., Limited, and the Japanese naval authorities, we are enabled to give our readers the following particulars of the vessel now building at the Elswick shipyard for the Imperial Japanese navy. Her length on the water-line is 455 feet; her breadth, 78 feet 2 inches; her draft, 26 feet 7½ inches; and her displacement, in tons, 16,400; and she will carry for her armament four 12-inch guns, twin mounted in barbettes; four 10-inch guns, mounted singly in barbettes; twelve 6-inch guns in the citadel, twelve 12-pounder guns, six Maxim guns, three 3-pounder guns, and five torpedo tubes. The diagram below shows the disposition of the above named armament, the arrangement of which has been most carefully considered, so that there is no intererference with one another in the firing of the different guns, which, however, are all capable of being trained through large arcs. The 12-inch guns are 26 feet and the 10-inch 22 feet above the water-line. The 6-inch guns in the battery are from 13 feet to 14 feet above the water-line.

The general disposition of the armor protection is that adopted in the latest and most powerful battleships, the armor amidships being carried from below the water-line right up to the upper deck. Above the level of the upper deck additional protection has been adopted, a 4-inch screen being worked to a height of 7 feet 6 inches above the upper deck, and extending between the 10-inch gun positions. The main armor belt, which extends the whole length of the vessel, has a thickness of 9 inches for more than half its length, tapering to rather less at the extremities. The depth of this belt is from 5 feet below water to 2 feet 6 inches above water. Immediately above this is a belt of 6-inch armor, extending in length from the after 12-inch barbette right forward to the stem. Above this again is the 6-inch citadel armor carried to the height of the upper deck, and enclosing the two 12-inch barbettes. In this citadel are placed ten of the 6-inch guns, divided from one another by screens of 80-lb. armor plating, and firing through ports similar to those adopted in casemates. This citadel arrangement, which is one of the most important features of this and other recent battleships, is really a revival or development of the old box battery arrangement adopted in some of our battleships built in the seventies, such as the Shannon and Alexandra. This arrangement fell into disuse when the great improvement made in ordnance—which for a time kept so far ahead of the improvements in armor—made it necessary to increase the thickness of the armor to make it efficient, and, therefore, it was only possible to cover a comparatively small area of the vessel's side. However, the recent improvements in armor have been such that again comparatively thin armor is efficient in keeping out projectiles, which has once more made it possible to protect a greter area of side. In more recent years the same system with protective divisions between the guns in the battery was adopted in the Nile and Trafalgar, but as the 4-inch armor protecting the battery of each of these vessels was not of a quality to keep out even the smaller armor-piercing shell, the system was not repeated until the latest and most improved armor was adopted in

such vessels as our King Edward VII class, and in the much talked of Swiftsure and Triumph. The remaining two 6-inch guns fire through similar ports in the 4-inch screen armor on the upper deck amidships. The barbette armor of the 12-inch guns is 9 inches thick on the upper portions where exposed, and 5 inches thick where protection is afforded by the citadel armor. The barbette armor of the 10-inch guns has a thickness of 6 inches, the conning tower armor is 9 inches thick, and the observer tower 5 inches thick. In addition to these two armored positions for commanding officers, three officers' shelters are to be built of 3-inch armor, one above the conning tower and one on each side. Besides the armor described above, a steel protective deck runs throughout the entire length of the vessel, the whole of the machinery, magazines, etc., being kept below. This protective deck has a thickness of 2 inches on the flat portions amidships, and 3 inches on the sloping sides, which are carried down to meet the bottom of the main armor belt. At the ends where the armor protection is reduced, this deck has a thickness of 2½ inches all over. Thick protective plating is also worked on the top of the screen armor at the boat deck level.

Special attention has been paid to the arrangement and disposition of the magazines, so that the ammunition can be got to all the guns with the greatest speed and minimum of trouble. There are independent magazines for each pair of 12-inch guns and for each 10-inch gun, and an ammunition passage is provided running right around the machinery spaces below the protective deck for the supply of ammunition to the various 6-inch and smaller quick-firing guns. The torpedo tubes are situated in water-tight chambers—two tubes forward and two aft firing on the broadsides, and one tube firing right astern, also under water. Special means are provided for rapidly clearing water from these submerged torpedo rooms in case of emergency.

The general particulars of the main propelling machinery and boilers are as follows: There are twenty Niclausse boilers disposed in three separate boiler rooms. These boilers will have a working pressure of 230 lbs. and a grate surface of 1300 square feet and a heating surface of 43,000 square feet. The twin engines will have four cylinders each, of 36 inches, 56 inches and 63 inches, with a stroke of 48 inches, and the horse power will be sufficient to give a speed of at least 18½ knots. The coal bunkers are so arranged as to reinforce the protection given by the armor and protective deck to the engines and boilers, whilst their disposition is such as to require very little trimming to get the coal to the furnaces. The bulk of the coal can also be got to the stoke-holds without opening any of the doors in the main water-tight bulkheads—a point of very great importance when the vessel is in action. In addition to the coal bunkers below the protective deck, reserve bunkers are arranged on the slopes of the protective deck up to the height of the main deck over the length of the machinery spaces amidships, the total capacity being approximately 2000 tons, which is sufficient to give the vessel a very large radius of action.

A very complete outfit is being provided for the vessel, including the following boats: Two 56-foot vedette torpedo boats of high speed, one 36-foot steam pinnace, one 40-foot launch, one 32-foot pinnace, three 30-foot cutters, two 30-foot gigs. For lifting these boats two powerful electrically worked derricks are provided—one on each side of the vessel.

There is also a powerful electrical equipment, both for providing energy for the numerous machines on board and also for lighting. The latter will include provision for six searchlights and some 1250 incandescent lamps.

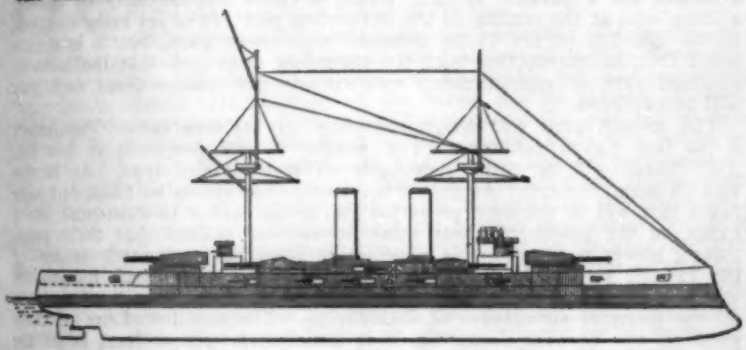
The equipment of anchors and cables includes three stockless bower anchors of 120 cwt. each, and other smaller anchors. There are also three main cables of 150 fathoms each of 2⅝-inch stud chain.

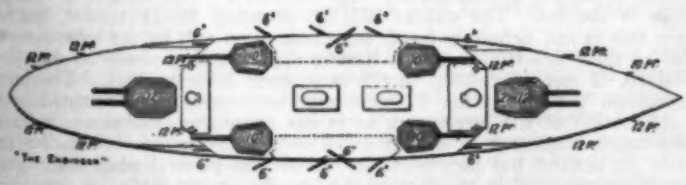
The vessel being of such an immense weight—over 17,000 tons with her full equipment of coal, stores, etc.—special arrangements have been pro-

vided for docking her with safety, and, in addition to showing ribbands for giving special support to the armor in dock, two docking keels are provided on the flat portions of the bottom under the bilge amidships. These keels will rest on separate lines of blocks in the dock, as well as the usual blocks along the middle line of the vessel. Bilge keels are also provided to reduce rolling in a sea-way.

The water-tight subdivision of the vessel is of a most thorough description; the inner bottom extends over the whole length of the vessel, and is minutely subdivided, and above this the number of transverse and longitudinal water-tight bulkheads is too numerous to mention.

An elaborate system of pumping and draining has been worked out, and in addition to the main pumps in the engine rooms, which can be used in case of emergency for dealing with a large inrush of water, are two 9-inch pumps, two 5½-inch and one 4½-inch, besides pumps for fresh and salt water services.





In a vessel of this description the ventilation arrangements are not the least important of the many items which have to be thought out, and every precaution has been taken for efficiently ventilating spaces both above and below the protective deck. In addition to the natural ventilation, artificial means have to be largely adopted, even in the upper portions of the vessel where she is entirely enclosed in with armor and protective plating, and here, as well as below the protective deck, numerous electrical fans, with air trunks, branches, pipes, etc., are being provided for.

Two complete sets of steering engines, independent of one another and in separate water-tight compartments, are fitted, with steering positions both forward and aft. Hand gear is also provided, and appliances for changing as quickly as possible from hand to steam gear, and *vice versa*. Tiller indicators are fitted in all the steering and conning tower positions. Helm signals are provided for the purpose of communicating the position of the helm to other vessels in the neighborhood. Voice pipes, telegraphs and telephones are fitted throughout the vessel to communicate between all the important positions. The vessel is also to be supplied with a wire-

less telegraphy installation. Torpedo net defense is to be fitted around the greater part of the vessel, which, in view of recent experience, appears to be not an unnecessary precaution.

With the exception of the main propelling machinery and boilers, which are being supplied by Messrs. Humphrys, Tennant & Co., the whole of the ship, with armor, armament, fittings, etc., will be supplied by Sir W. G. Armstrong, Whitworth & Co., Limited.

The 12-inch guns will weigh approximately 59 tons each. The length is 46 feet 9½ inches (46.7 calibers). The weight of the projectile is 850 lbs. The charge will be cordite, probably of the modified type. The exact weight of the charge is not yet fixed, and neither can the velocity be given, but these guns will be the most powerful 12-inch guns which have yet been constructed. No armor which any ship can carry can hope to cope with their penerating powers at 3000 yards. The breech screw is arranged for a parallel motion, which obviates the necessity of having a steep cone at the seating of the obturating pad. It is yet early to speak of the rapidity of fire to be obtained with these guns, but it is anticipated that, in conjunction with the mounting described, that the hitherto obtained rate of approximately two rounds per minute from each gun will be exceeded.

The 10-inch guns will weigh approximately 34 tons each. The length is 39 feet (46.76 calibers). The weight of the projectile is 500 lbs. The charge will be cordite, probably of the modified type. As in the 12-inch guns, the exact weight of the charge has yet to be fixed, but here again this will be the most powerful gun of its caliber in existence. As a gauge of the power of these guns, it may be noticed that their penetrating power is equal to the penetrating power at 3000 yards of any of the 12-inch guns at present afloat in any navy. The breech mechanism will be somewhat similar in design to that of the 12-inch, and will embody all the essential advantages of that design. The rapidity of fire of these guns on the Elswick mounting, it is anticipated, will at least be at the rate of three rounds per minute with a well drilled gun's crew.

The 6-inch guns will weigh approximately 8½ tons. The length is 23 feet 6 inches, approximately (47 calibers). The weight of the projectile is 100 lbs. The charge will be probably M. D. cordite, but here again this is not definitely fixed, but these guns will be the most powerful guns of their description made, having a penetrating power at 3000 yards equal to, if not exceeding, any 6-inch guns hitherto built. The breech mechanism will be of the Elswick modified coned type, actuated by the single motion of the lever, and, as in the other gun, the necessity for the steep-coned obturator is obviated. The exact type of the smaller guns is not yet settled, but they will also follow the general advances in power and efficiency noted in the case of the heavier armaments.

12-inch gun mountings.—The 12-inch guns are mounted forward and aft on the midship line, as shown in the sketch of the ship. Owing to the powerful nature of the guns, these mountings are necessarily stronger than any hitherto manufactured in this or any other country. The design is arranged with a view to occupying the least possible space in the ship, and at the same time to give ample room for working the machinery. The general features of the design are the turntable proper, containing the mountings for the gun, the working chamber underneath into which the ammunition is received from the magazine and shell rooms in preparation for sending up into the secondary or loading hoist, the trunk connecting the working chamber with the magazines and shell rooms, and the hoist connecting the working chamber and the gun. This latter hoist is so arranged that a gun can be loaded at any angle of elevation or training. The charge for each gun, consisting of the projectile and the cordite charge, the latter in two halves, is brought up at one time in a loading cage, which is automatically stopped in its proper position in line with the breech opening of the gun. It is then rammed home by means

of a chain rammer actuated by a hydraulic motor. The breech-block of the gun is opened or closed by a hydraulic motor, thus enabling this operation to be performed with great rapidity. In the working chamber, by an ingenious arrangement, the projectile and the two halves of the cordite charge are simultaneously transferred from the cage which works in the trunk connecting the shell rooms and magazines with the working chamber, to the cage working in the hoist connecting the working chamber with the gun position. The ammunition trunk is of a new design, which enables the ammunition cage always to come to the same position in the magazines and shell rooms; but when it is brought up to the top of the trunk the cage is in its proper position with respect to the ammunition loading hoist, although the turret may be revolving at a quick rate; or, in other words, the ammunition trunk does not revolve at the bottom, but revolves with the turntable at the top. The guns are protected by 10-inch hard armor in the front, and 8-inch at the sides and back. The feature of the turret is that it is quite balanced, thus enabling it to be readily trained by hand, although the ship may have a heel at the time.

There are three systems for performing the operation of training, primarily by hydraulic power, and should this fail through any of the piping being shot away, electric training gear can be quickly put into operation; and finally, should this be disabled, the turret can be trained by hand. Similarly the operation of elevating and depressing the gun can be performed by working primarily by hydraulic power, and then either by electric or hand. The operations of loading can also be performed by hand should the hydraulic system be disabled. To safeguard against accident by freezing in the intense cold which is found in the China seas during the winter months, heating apparatus is fitted throughout the turret installation. The gun mountings are so arranged as to give the gun 18 degrees elevation and 3 degrees depression, a greater range of elevation than has hitherto been provided for mountings of this description. The training angle is arranged for 270 degrees, that is to say, from right ahead or right astern to 45 degrees before or abaft the beam. The turret can be trained at the rate of one complete revolution (viz., 360 degrees) per minute. In the shell room, suitable overhead hydraulic lifting and traversing arrangements are made for lifting the shell out of the bays and placing them in the cage, but this operation can also be done by hand should necessity require it.

The sighting of the guns is provided for by a central sighting station and two side sighting stations, one on the left and the other on the right. By an ingenious arrangement the captain of the turret is enabled by working one lever to train or elevate the gun or to perform both these motions at the same time. Voice pipes and other apparatus are fitted to enable the officer in charge of the turret to communicate his orders to the magazines and shell rooms. A complete system of electric circuits enables the guns to be fired from any one of the eight positions either simultaneously or independently. Percussion firing arrangements are also provided.

10-inch gun mountings.—Each 10-inch gun is placed in an armored revolving gun-house or turret. The ammunition is sent up in a lifting cage from the magazine and shell room direct to the gun platform, each cage containing a projectile and cordite charge in two parts. On reaching the gun platform the projectile is quickly transferred to a hinged loading tray fixed on the gun cradle by means of an intermediate resting tray, the cordite being transferred by hand to the loading tray. By this arrangement three projectiles are always in waiting for loading, insuring rapidity of fire. The projectile and charges can then be rammed into the gun by a telescopic hydraulic rammer. This rammer is arranged to follow the gun in elevation or depression so that it always remains in line with the gun axis, enabling the operation of loading to take place at any angle within the usual fighting limits. The training of the gun-house is performed as in the case of the 12-inch, primarily by hydraulic power; then

by electric, and finally, if necessity occasions it, by hand, and like the larger mounting, it is balanced so that the operation of training by hand can be readily performed although the ship may have a heel. The breech-pedestal. This pedestal is bolted to the ship's structure, the elevating arrangements are attached to the cradle, thus enabling the elevating gun number to work the gear even during the firing of the gun without injury to himself. Telescopic sights are fitted in a convenient position. Electric circuits are fitted to enable the guns to be fired by the simple operation of pressing the trigger of a pistol. Arrangements for percussion firing are also provided. A circular shield is attached to the revolving Y piece so as to keep the port opening in the ship's side blocked up at any angle of training. This port opening allows for the guns to be trained through a range of 120 degrees, viz., 60 degrees before the beam and 60 degrees abaft.

12-pounder gun mountings.—The 12-pounder mountings are similar in principle to the 6-inch above described, but, of course, arranged to suit the smaller size of the gun. They are protected by revolving shields attached to the Y pieces by elastic stays.

Torpedo tubes.—The vessel carries four 18-inch torpedo tubes on the Armstrong-Whitworth principle, which has been fitted to all the Japanese warships built either in this country or abroad since the date of the Fuji and the Yashima, which were the two first ships to have this apparatus. The vessel will be fitted with a torpedo tube for firing 18-inch torpedoes in the line of keel astern. This also will be a special design by the builders.

The ammunition supply to the 12-inch and 10-inch guns has been described under the heading of mountings for these guns. The ammunition supply for the 6-inch and 12-pounder guns is arranged for by supplying to each 6-inch gun an electrically driven ammunition hoist of the improved Elswick design. These hoists will bring up the projectile and the cordite charge, and maintain a continuous supply. The operation of the hoist is extremely simple, and necessitates the minimum personal attendance. The seaman working the hoist has only to start it in motion and then keep it supplied with the necessary ammunition, which is automatically discharged in a position best situated for the working of the gun. The hoists for supplying the 12-pounder guns are of similar design; eight of them will be placed in suitable positions for supplying the 12-pounder guns.—*Engineer.*

The manner in which the machinery of the Japanese destroyers has apparently stood the strain of actual war without any material deterioration or defect is at once the admiration and astonishment of all students of the war. A writer in the *Globe*, commenting on this circumstance, says: "No instance, so far as I am aware, has been recorded of the failure either in guns or machinery of any vessel in the Japanese navy. Boilers do not appear to have caused any great amount of anxiety; no explosion of tubes has been heard of, and certainly no mention has been made in the papers of heated bearings or piston rods, of leaky condenser tubes or steam-pipe joints, and although we may concede that the Japanese engineers are the equals of any in the world, it requires something more than such excellence of *personnel* to account for the prolonged immunity from disablement which characterizes the history of the Japanese fleet in this war. And the question immediately faces us, 'To what particular cause, or combination of causes, is this immunity traceable?' I venture to suggest three: (1) The larger liberty given to the builders, permitting them to exercise greater discretionary powers in the selection both of scantling and material; (2) greater freedom of design, and less limitation as to weights; (3) superiority of materials, and larger bearing surfaces. When we have granted all these, there still remains the undeniable fact that the Japanese engineers deserve the greatest possible credit for the manner in which they have handled their machinery." —*Army and Navy Gazette.*

ITALY.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Roma	12,625	Gov't Yard, Spezia	Building.
Napoli	12,625	Gov't Yard, Naples.	"
X	12,625	Gov't Yard, Castellamare	Projected.
Vittorio Emanuele	12,625	Gov't Yard, Castellamare	Launched Sept. 20, 1904.
Regina Elena	12,625	Gov't Yard, Spezia	Launched June 19, 1904.
Armored Cruiser.			
Francesco Ferruccio.	7,400	Gov't Yard, Venice.	Under trial.

The new battleship Regina Elena was launched at Spezia on June 19, in the presence of the King of Italy. Preparations are also being made for the launching of the Vittorio Emanuele at Castellamare about the middle of August. The Roma should be ready to take the water about the middle of November, and the Napoli should leave the slips some time early in 1905.

The Italian naval estimates for 1904-05 amount to £5,087,643, which is £343 in excess of the estimates for the previous financial year. The amount apportioned to new construction is £1,533,469. This sum is to be devoted to the completion of the armored cruiser Francesco Ferruccio, the further construction of the battleships Regina Elena, Vittorio Emanuele, Roma and Napoli, and the commencement of a new armored cruiser at Castellamare, three submarines at Venice and fourteen torpedo boats. The two destroyers Teffiro and Espero are to be completed also.

The new armored cruiser is to be the first of a class of seven of 10,000 tons. It is also reported that the construction of fourteen torpedo-boat destroyers and forty torpedo boats is in contemplation, but that it has been deferred until next year.—*Page's Magazine.*

The *Italia Militare e Marina* states that at her machinery trials the Italian battleship Regina Margherita during a three hours' run under natural draft averaged a speed of 19.3 knots, her engines developing an average of 18,900 horse power. Under forced draft her engines developed an average of 20,000 horse power, touching at times 23,000 horse power. This is 1000 horse power above the contract power. Her average speed was 20.2 knots. She is fitted with Niclausse boilers made by the firm of Ansaldo-Armstrong.—*United Service Gazette.*

RUSSIA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Emperor Paul I.	16,000	St. Petersburg (Baltic Yard).	Building
Andrei Pervosvannui	16,000	St. Petersburg (Galerney Island).	"
Imperator Alexander III.	13,156	St. Petersburg.	Under trial.
Borodino	13,516	"	"
Orel	13,516	"	"
Kniaz Suvarof	13,516	"	"
Slava	13,516	"	Launched Aug. 29, 1903.
Evstafi	12,500	Nicolaiev.	Building.
Ivan Ziatoust	12,500	Sevastopol.	"
Coast Defence Iron Clad.			
Admiral Boutakof	6,000	St. Petersburg.	Building.

VESSELS BUILDING.—*Continued.*

Name.	Displacement.	Where Building.	Remarks.
Protected Cruisers.			
Oleg	6,750	St. Petersburg.	Launched Aug. 27, 1903.
Kagul	6,750	Nicolaiev.	Under trial.
X	6,700	"	Building.
Otchakof	6,750	Sevastopol.	Under trial.
X	6,750	"	Building.
Vitiaz	6,750	St. Petersburg.	"
X	6,750	"	"
Boyarin	3,200	Copenhagen.	Under trial.
Kalgoula	3,200	Nicolaiev.	Building.
Almaz	3,200	St. Petersburg.	Launched June 2, 1903.
Zemtchug	3,200	"	Under trial.
Izumrud	3,200	"	" "
7	3,200	Dantzic (Schichau).	Building.
8	3,200	St. Petersburg.	Projected.

Reports from various sources state the Russian naval program for 1905 includes the construction of eight new battleships of the Imperator Pavel I type and several armored cruisers of the Bayan class. This report comes from both German and Italian sources, but the German report states that some of the vessels are to be built in France, a rumor which is in direct contradiction of the Imperial ukase ordering all Russian war vessels to be built for the future in Russian yards. One of the armored cruisers, it is reported, will be paid for by public subscription, and named the Admiral Makharoff.

Three new torpedo-boat destroyers, the Totschnii, Twjordii and Treshnii, have been laid down at Creighton's Yard, and are to be completed with all dispatch.

The Holland Torpedo Boat Company, of New York, is stated to have received an order from the Russian Imperial Government to build and complete five submarines within eight months. Five others are believed to have been ordered from Vickers, Sons & Maxim, to be completed in the same space of time.—*Page's Magazine.*

The Imperator Alexander III. is the only one of the five remaining battleships of the 1898 programme which is as yet ready for sea. As far as present information goes, it is unlikely that any of the others can be completed for some time yet; the Kniaz Suvarov is probably the most advanced, but she has not yet commenced her trials; the Borodino was brought down from St. Petersburg to Cronstadt in the spring, but her armor had to be removed before she could pass through the Canal; the Orel severely strained herself when she went ashore, also while coming down fom St. Petersburg; while the Slava, launched last autumn, cannot possibly be completed for another year.

The training squadron in the Black Sea began its instructional duties on the 14th June. The squadron consists of the battleships Georgei Pobiedonosets, Tri Sviatitelia, Rostislav, and Ekaterina II., with the torpedo-aviso Kasarski, the mining-steamer Dunai, and eight torpedo-boats.

The Libau dockyard has been very busy in fitting out as auxiliary cruisers the merchant-steamers Fürst Bismarck, Columbia, Maria Theresia, Auguste Victoria, and Belgia, recently purchased in Germany; these vessels have been renamed the Don, Ural, Texel, Kuban, and Irtitsch; whilst the Franche Conté, purchased in France, has been called the Anadir.

The Naval Technical Committee has decided to replace the Russian Popoff wireless telegraphy system, at present in use in the Russian Navy, by the German Slaby-Arco-Braun system, which has been perfected by the Siemens-Halske firm, and has shown itself far superior to the Popoff, both in rapidity of working and in the distance to which messages can be transmitted by it. All the ships now fitting out for the Far East are to be fitted with it, and the German firm has also received instructions for

the erection of two wireless telegraphy stations on the Lake Baikal, one at Baikal, and the other at Tanchoi, on the opposite side of the lake.

The want of naval officers is already beginning to show itself. From 1875 to 1900, an average of 58 cadets from the Naval Cadet Corps were advanced to sub-lieutenant, of whom some 40 rose to the higher grades. In the next three years, the numbers were increased to 75, 110 and 130, but at present there are not enough cadets to meet the requirements of the fleet. In order to obtain a sufficient number of candidates, the press is now agitating for a repeal of the old regulations, under which only youngsters of noble birth are eligible for admittance to the Cadet Corps, and the demand is made that the naval service should be thrown open to all Russian youths who can pass the necessary examinations.

THE VOLUNTEER FLEET.—Some details in regard to the Volunteer Fleet, a force which has recently come prominently under notice, owing to the performances of two of the ships of the Red Sea, may be of interest.

The ukase permitting the formation of the Volunteer Fleet was signed on the 30th May, 1878, and its constitution was based on a Prussian ordinance of the 24th July, 1870, calling into being a somewhat similar force during the Franco-German war. The principal articles of the ukase are as follows:

1. The Volunteer Fleet is created with the view of increasing, in time of war, the naval forces of the country by ships having their commanders and crews already on board.

4. The volunteers or crews on board are to be placed at the disposal of the Minister of Marine.

5. The owners, who wish to place their ships at the disposal of the Minister of Marine for war purposes, must make a declaration stating the terms on which they wish to sell.

6. If the department finds the ships in good condition, and the terms proposed by the owners reasonable, the vessels will be inscribed as ships of war.

7. The men on board (the Militia of the Fleet) will, on entering active service, be inscribed on the rolls of the active *personnnel* of the Fleet.

8. Their officers will be entitled to rank: the commanders as corvette-captains, their mates as lieutenants.

9. The period of service under the man-of-war flag will be counted as active service.

10. While thus serving, the officers and men will be subject to the rules and regulations in force for the Imperial Navy.

11. In case of wounds, they will enjoy the same rights as the seamen of the Active Fleet.

The first subscription, which was opened on the 2nd July, 1878, under the patronage of the then Tsarevitch, produced in a short time, four million roubles (£416,667), and three large steamers were bought from the Hamburg-American Company. Since that date, the fleet has been steadily increasing; in January, 1886, it numbered 8 steamers, with a combined displacement of 50,860 tons, and 33,308 I. H. P., and received a subsidy of 17,500 roubles (£1823).

In January, 1895, the subsidy was increased to an annual grant of 600,000 roubles (£62,500), for a term of 10 years, in order that the Company might replace their old *matériel*, and four new ships of at least 8000 tons displacement, and with a speed of not less than 17 knots, were to be constructed, with two cargo steamers for the transport of *matériel*. In 1898 the fleet was composed of 14 large steamers, the oldest dating from 1888. Their total displacement amounted to 128,000 tons, with an I. H. P. of 84,000. The ships forming the fleet, at the beginning of the war, were the following:

1. Kostroma, Tamboff, Nigi-Novgorod, Orel, Saratov, and Yaroslav, 1888 to 1893. These vessels were from 7900 to 8200 tons displacement, with a speed varying from 14 to 18 knots.

2. Petersbourg, Kasan, Kherson, 1893 to 1896, of from 9000 to 10,500 tons displacement, 12,000 I. H. P., with a speed of 19 knots.

3. Smolensk, Moskwa, Bogatyr, Ouragan, Poltava, 1898-1901, of from 11,000 to 12,000 tons, with engines developing from 13,000 to 16,000 I. H. P., giving a speed of 20 knots. With the exception of the Kostroma, all these vessels are twin-screwed, and they were all built in English yards. There are, in addition, four transport ships, of 10,500 tons displacement, 3000 I. H. P., and 13 knots speed; the Ekaterinoslav, Kief, Voroney, and Vladimir, 1895-1896. Nearly the whole fleet were constructed by Messrs. Hawthorn and Leslie, on the Tyne.

SPAIN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Protected Cruisers.			
Reina Regente.....	5,372	Ferrol.	Building.
Isabel la Catolica	8,500	Canaca.	"

SWEDEN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Coast Defence Battleships.			
Oscar II.....	4,200	Stockholm.	Building.
Manligheten.....	3,650	Malmö.	Launched.
Tapperheten	3,650	Stockholm.	"
Armored Cruiser.			
Fylgia.....	4,600	Stockholm.	Building.

UNITED STATES.

VESSELS BUILDING.

No.	Name.	Speed. Knots.	Where Building.	Degree of completion June 1. per cent.	Sept. 1. per cent.
	Battleships.				
12	Ohio.....	18	Union Iron Works.	94.5	99.
13	Virginia	19	Newport News Co.	61.2	68.5
14	Nebraska.....	19	Moran Bros. Co.	49	58.7
15	Georgia	19	Bath Iron Works.	54.1	63.3
16	New Jersey	19	Fore River S. & E. Co.	63.7	69.4
17	Rhode Island	19	Fore River S. & E. Co.	60.7	69.9
18	Connecticut	18	Navy Yard, New York.	42.1	50.
19	Louisiana.....	18	Newport News.	49.3	58.5
20	Vermont	18	Fore River S. & E. Co.	8.9	16.3
21	Kansas	18	New York S. B. E. Co.	9.6	22.1
22	Minnesota	18	Newport News Co.	29.6	39.3
23	Mississippi.....	17	Cramp & Sons.	3.5	7.7
24	Idaho.....	17	Cramp & Sons.	3.2	7.5
	Armored Cruisers.				
4	Pennsylvania.....	22	Cramp & Sons.	80.5	88.7
5	West Virginia.....	22	Newport News Co.	85.5	91.6
6	California.....	22	Union Iron Works.	69.5	83.4
7	Colorado	22	Cramp & Sons.	84.9	91.8
8	Maryland.....	22	Newport News Co.	82.8	88.2
9	South Dakota	22	Union Iron Works.	57.5	61.
10	Tennessee	22	Cramp & Sons.	34.4	43.7
11	Washington	22	New York S. B. Co.	29.3	41.4

VESSELS BUILDING—*Continued.*

No.	Name.	Speed, Knots.	Where Building.	Degree of Completion June 1. per cent.	Sept. 1. per cent.
	Protected Cruisers.				
18	Chattanooga.....	17	Lewis Nixon.	84.2	94.6
17	Galveston.....	17	Wm. R. Trigg Co.	81	89.
20	St. Louis.....	22	Neafie & Levy.	42.6	48.8
21	Milwaukee	22	Union Iron Works.	50.5	57.
22	Charleston.....	22	Newport News Co.	73.1	81.4
	Gunboats.				
17	Dubuque.....	12	Gas Engine & Power Co.	46.6	58.4
18	Paducah	12	Gas Engine & Power Co.	35.7	53.6

PROGRESS ON THE NAVAL PROGRAM.

WASHINGTON, D. C., August 16, 1904.—The plans of the Navy Department for the letting of contracts for the vessels authorized at the last session of Congress have been materially modified. The program includes eight vessels which, as recently named by the Secretary of the Navy, are as follows: The battleship New Hampshire, the armored cruisers North Carolina and Montana, the scout ships Chester, Birmingham and Salem, and the colliers Erie and Ontario. The two colliers are to be built in Government yards.

The decision of the Department not to hasten the advertising and letting of contracts is based upon two considerations: First, the importance of the early delivery of vessels now in course of construction, which it is believed would be delayed if other contracts should be at once awarded; and second, the desire of the Department to secure as much competition as possible for the new contracts, which can only be obtained when several of the yards have completed at least a part of the Government work now on hand. A survey of conditions in the leading yards, based upon the current monthly reports, supplemented by special inquiries, shows that little or no progress on new contracts could be made by these yards during the coming five or six months, as each establishment is now carrying along as much naval work as can be handled to advantage.

WARSHIPS NOW BUILDING.

The Cramp Shipbuilding & Engine Company, for example, is now at work upon the battleships Mississippi and Idaho, which are only about 65 per cent completed, and upon the armored cruisers Pennsylvania, 84.2 per cent; Colorado, 89.2 per cent; and Tennessee, 42.45 per cent. The Newport News Shipbuilding & Dry Dock Company has on hand the battleships Virginia, 63.7 per cent; Louisiana, 52.59 per cent; and Minnesota, 37.56 per cent; and armored cruisers West Virginia, 89.32 per cent; and Maryland, 86.87 per cent; and the protected cruiser Charleston, 79.5 per cent. The Fore River Ship & Engine Building Company is building the battleships New Jersey, 63.8 per cent; Rhode Island, 66.1 per cent; and Vermont, 13.4 per cent. The New York Shipbuilding Company is constructing the battleship Kansas, 17.7 per cent, and the armored cruiser Washington, 38 per cent. The Union Iron Works is completing the battleship Ohio, 97 per cent; the armored cruisers California, 62 per cent; and South Dakota, 59 per cent; and the protected cruiser Milwaukee, 54 per cent. The Moran Brothers Company is building the battleship Nebraska, 54.3 per cent, and the Bath Iron Works is constructing the battleship Georgia, 59.3 per cent. Lewis Nixon has under construction the protected cruiser Chattanooga, 91.9 per cent. and the torpedo boats Nicholson, 99 per cent, and O'Brien, 98 per cent. The protected cruiser Galveston, 87 per cent, is under contract to the Wm. R. Trigg Company, and the St. Louis, of the same class, 44.6 per cent, to the Neafie & Levy Company. The Gas Engine & Power Company is building the gunboats Dubuque,

52.7 per cent, and Paducah, 45.2 per cent. Three more torpedo boats are under construction, as follows: By the Harlan & Hollingsworth Company, the Stringham, 99 per cent; by Wolff & Zwicker, the Goldsborough, 99 per cent; and by George Lawley & Son, the Blakely, 99 per cent.

With the facilities of the leading yards for naval construction thus heavily taxed, and with the relatively large number of vessels rapidly nearing completion, the Navy Department officials believe it to be advisable to permit the contractors to concentrate their efforts upon the finishing up of as many vessels as possible in the next few months, and that no time will really be lost in the progress of the general naval program if the letting of new contracts is postponed until the end of the current calendar year.

PLANS FOR NEW VESSELS.

The plans for the battleship New Hampshire are practically completed, but she will probably not be advertised before October 1. This vessel belongs to the Connecticut-Louisiana class, and the Government hopes to secure a very low price for her construction, in view of the fact that the Newport News Shipbuilding & Dry Dock Company is constructing the battleships Louisiana and Minnesota, and has all the necessary plans and patterns on hand. The armored cruisers North Carolina and Minnesota will follow the general lines of the Pennsylvania class, but will be equipped with submerged torpedo tubes. The plans for these vessels have been somewhat delayed, owing to questions that have arisen concerning the armament, but the Department will probably be ready to advertise for bids for their construction some time in October.

Very slow progress is being made with the designs for the three scout ships, the Department experts finding themselves heavily handicapped by the specifications of the appropriation bill regarding tonnage and speed, taken in connection with the desire to give these vessels unusually high superstructure. The latter feature of the original design is likely to be modified somewhat, and the final plans of these three vessels will approximate those of a torpedo-boat destroyer much more closely than was at first anticipated. In spite of rumors to the contrary, it can be stated positively that the Department has not abandoned the intention to equip two of these cruisers with turbine engines. The ordinary reciprocating marine engines will be installed in the other vessel.

No work will be done on the two colliers, authorized by the naval appropriation bill to be built in Government yards, until Congress has been given an opportunity to reconsider its action. As heretofore stated in these dispatches, one of these vessels will be built at the Brooklyn yard, but, inasmuch as the law requires that the other shall be built on the Pacific Coast, where at present there is no yard equipped for the work, it has been decided to advise Congress of the situation and to request a special appropriation to build a slip and provide the necessary tools and machinery. Recently the question has been raised as to the advisability of equipping one of the Pacific Coast yards for this purpose, and it may be suggested to Congress that this provision of the law be amended, so that, if a special appropriation is made, it will be available for use at one of the Atlantic yards, in the discretion of the Secretary of the Navy.

THE LOUISIANA-CONNECTICUT CONTEST.

Much interest attaches to the competition between the Newport News Shipbuilding & Dry Dock Company, which is building the battleship Louisiana, and the New York Navy Yard, where her sister ship, the Connecticut, is being constructed by the Government. The two vessels are about abreast of each other, the Louisiana being 52.59 per cent completed, while the Connecticut stands at 47.3 per cent. The former will be launched on August 27 and the latter on September 29. Under the act of Congress authorizing the construction of these two vessels, the Depart-

ment was directed to keep an accurate account of all expenditures, with a view to determining the relative cost of Government and private work. Every effort is being exerted by the Bureau of Construction and Repair to make a creditable showing, and it is doubtful whether the results obtained will fairly represent the work of Government establishments under ordinary conditions.—*Iron Age.*

ORDNANCE AND GUNNERY.

BATTLESHIP ARMOR AND GUN ATTACK.—In three years, says *Engineering*, in the course of an article on the above subject, the velocity of the latest type of naval guns has gone up about 150 feet per second, and the factor of penetration of the armor-piercing projectile has improved by 10 to 15 per cent. Moreover, the "cap" has now been universally adopted; in this country the Vickers Company have consistently worked to establish its superiority. From these considerations it results that a 12-inch gun—which in 1901, under certain conditions of range and obliquity of impact, might be considered as fairly matched by 12-inch plate—can now deal with 15-inch or 16-inch plates on much the same terms as its prototypes did with the thinner armor. Making allowance for the effect of protective sloping deck and of the coal behind the armor in the region of the machinery space, it is shown that the total resistance in the King Edward class is equal to 12½ inches of Krupp steel. This, however, can be pierced with the greatest ease by an old type 12-inch shot at over 5000 yards range, while the 9.2-inch or the German 9.4-inch would, if it hit exactly normal, send a capped shell into the engine room or barbette at between 3000 and 4000 yards range. Thus the King Edward class, it is said, will barely keep out capped shot from the 9.2-inch gun at moderate range. An examination of the situation shows that the range of piercing by a 12-inch gun using even uncapped shot would be, in the case of the King Edward class, 5500 yards; in the French République, 3700 yards; in the United States Connecticut. 4000 to 4500; in the German Braunschweig, 4000 to 5000 yards; and, according to particulars given, in the new Japanese battleships now building in this country by the Vickers Company, over 5000 yards. While the German and British ships named have at no part on the broadside armor of greater thickness than 9-inch, the two other ships are partly clad with 11-inch Krupp steel, and the assumption made by some writers on armor is that any future design should have a belt 11 inches to 12 inches thick in the center, tapering to 9 inches below the water-line, and to not more than 7 inches from, say, 4 feet above the water-level to the top. This tapering under the water-line is already applied to the French and American ships. It is not approved, however, by Sir William White, because, as pointed out in our contemporary, a ship which rolls through 9 degrees to 10 degrees is apt to expose the hull under the armor; while, as Sir William further points out, wave formation at high speeds may bring about similar exposure. Some authorities on armor. on the other hand, prefer to take the chance of a blow under the normal water-line, as this part cannot be hit unless the shot has traversed some water. In nearly all the battleships the broadside is now tapered in thickness from some distance above the water-line to the upper deck; but it is contended that in the British ships the maximum thickness need not be carried quite so far above the water-line. In order to increase the thickness of the belt and the armored sloping deck behind the belt where necessary, weight must be taken, in the case of the King Edward class, at all events, from the armor forward, from the upper protective deck, or from the main deck before the fore barbette, which is some 12 feet above water and 2 inches to 1½ inches thick; even then he admits that an increase in displacement would be necessary.

The lack of progress of the Admiralty in reference to guns, continues

Engineering, is certainly not reassuring. There are twenty-eight British ships, now ranked amongst the most important in our fleet, which have short, old-type guns, as compared with sixteen in the navies of the four other principal sea Powers—France, the United States. Russia and Germany. Again, France, Russia and the United States are all manufacturing now 45-caliber 12-inch guns for the latest ships, while we are content with 40-caliber 12-inch guns. There are, however, rumors of a new 45-caliber gun. In addition to the greater length, enormously increasing the striking energy and flattening the trajectory, whereby the danger zone is lengthened, there is the further advantage that the long gun carries the blast clear of the ship's side when firing the forward guns abaft the beam or the aft guns before the beam. The new type of capped projectile is from 25 per cent to 33 per cent more powerful, so far as direct impact is concerned, than when the whole type of uncapped shot is used; while it is further pointed out that there is a considerable extension of the practice of using a powder with a low percentage of nitroglycerine in preference to cordite. In view of the development in both directions, it seems, adds *Engineering*, surprising that uncapped armor-piercing projectiles are still used in the British service for the proof of armor plates, because there can be no doubt that in actual service the armor on our ships will be called upon to withstand the attack made by such shot; and, as a writer on armor points out, the time cannot be far distant when plates will be proved by the same type of projectile that they will have to face in action.—*United Service Gazette.*

The disaster in the Missouri of the United States navy some little time back was very nearly repeated in British ships the other day, if reports from usually trustworthy sources are to be credited in this instance. It appears that some ten or twelve seconds after a fresh projectile had been rammed home to its seating in one of the 10-inch guns of the Swiftsure, a large volume of back flame was observed to issue from the gun, similar to that which caused the Missouri explosion. The dangers attendant upon this egress of back flame will be readily understood, especially when it occurs after the projectile has been rammed home, as then the new charges are exposed in the rear of the gun. To counteract this danger it has been proposed that the chamber of the gun should be washed out after the projectile has been rammed home instead of before, as is at present done. This would mean an extra pause between the plugging of the breech end of the bore with the projectile and the exposure of the charges in the rear. The remedy is a simple one, and there is no apparent reason why it should not be tried. In view of the disastrous experience of the Americans, no reasonable precautions to safeguard the lives of our men can be neglected.—*Army and Navy Gazette.*

It is stated that the Good Hope, flagship of the Cruiser squadron, whilst at target practice off the coast of Morocco, made 42 hits out of 120 rounds at a distance of 6000 yards.—*United Service Gazette.*

The sighting arrangements for the 7.5-inch guns of the Triumph, which has been fitted by the firm of Messrs. Vickers Sons and Maxim, is reported as being far ahead of anything yet introduced into our navy in ships designed at the Admiralty and completed in our Royal or private dockyards. It is also considered to be in advance of anything yet adopted by our gunnery experts at the Gunnery School. The Triumph's sights have a cross connection, which, it has long been felt, was a great desideratum with guns on transferable mountings, and where the sights are fitted to the mountings, rather than shipped in holes in the guns, as was the old plan with all our heavier guns, and still obtains with quick-firing guns of a lighter nature than 12-pounders. The sighting of the 14-pounders of the Triumph is also

an advance on our 12-pounders. Among other advantages, this system of a cross connection allows the sight-setter to work more freely on the opposite side of the gun to that on which the gun-layer is performing his functions of laying and firing the guns, and he is thus given more room and freedom for this work. At many of our guns in the secondary armament it will, in future, be arranged that the gun-layer shall use the left sight for keeping the gun laid for elevation, and pressing the trigger when the sight comes on, while the gun-trainer, who will be an equally important gun number, will, by means of the right sight, follow the object and keep the gun constantly bearing on it so far as the training is concerned. The sight-setter will likewise be on the right of the gun, and with a cross connection between the right and left sight. The two men concerned with keeping the gun laid for elevation and training—the gun-layer and gun-trainer—will both be doing their part with their sights adjusted simultaneously, and without affecting other operations. This is a very important matter nowadays. With this combination—if the sights are not faulty—and smart gun-loading numbers, there should be further developments in rapid hitting.—*Engineering.*

The Canadian Government is negotiating with the Armstrong Company to establish a cartridge and cordite factory at Ottawa.—*United Service Gazette.*

THE SHORT LEE-ENFIELD RIFLE MARK I.

Communicated by the Director of Artillery.

Prior to the South African war, the question of the modification of the service rifle for infantry had been considered, and a small committee had been appointed to devise such a rifle. The committee's labors were suspended owing to the outbreak of the war.

The experiences of the South African war brought into prominence the great importance of accurate and rapid snap-shooting at ranges such as 600 yards and under, and during the war Lord Roberts telegraphed home pressing for the short rifle to be proceeded with. It was therefore decided to carry out trials with a rifle which would be capable of using the existing service .303-inch ammunition, and which would be more suitable for the above mentioned class of shooting than the existing rifle, and would be at least equal to the latter in other respects.

The South African war also showed that greatly increased importance must be attached to the fire action of cavalry and other mounted troops, and that the firearm, and not the *arme blanche*, must be regarded as the principal weapon of the cavalry. There was ample evidence that the cavalry considered themselves placed at a disadvantage by having carbines, and in consequence these were withdrawn from, and long rifles given to, them. These conclusions necessitated the provision of the best weapon possible for mounted troops, and it was held that a rifle about five inches shorter than the Lee-Enfield was the longest which could be conveniently carried by cavalry.

Prolonged trials were therefore carried out to seen if a shortened rifle could be produced which would be at least as accurate and effective as the long rifle, and would meet modern conditions more satisfactorily in such respects as rapidity and ease of loading, handling and aiming, accuracy and convenience of sighting arrangements, lightness, etc., and would be suitable for all arms of the service.

As preliminary trials showed promise that these conditions could be met, one thousand shortened rifles were issued in 1902 to the Royal navy, Royal marines, and the first three army corps. One hundred of these rifles were subsequently sent to Somaliland. The rifles were not all of the same pattern, but embodied variations in sights, etc.—e. g., wind-gauges, bead fore-sight, etc.

After a full consideration of the reports received from the above sources,

the new pattern short Lee-Enfield rifle was adopted, as it was considered to meet the requirements of modern fighting, both for mounted troops and infantry, better than a rifle of greater length.*

The Russian cavalry has for a long time been armed with a rifle which is practically an universal weapon, the same as their infantry weapon. It is 51¼ inches long.

DESCRIPTION.

The new rifle is five inches shorter and 1 lb. to 1¼ lbs. lighter than the present Lee-Enfield Mark I† rifle.

The magazine holds ten rounds, and is filled by cartridges carried in chargers holding five rounds each in a manner similar to the Mauser rifle. Guides to hold the charger are fitted on the bolt-head and body, and the five cartridges can be pressed out of it into the magazine by the thumb, and to facilitate this the body is cut away somewhat on the left side. There is no cut-off, except in rifles made for the navy. There is a safety catch on the left of the body which locks the bolt and cocking-piece in either the full cock or fired position. The catch is also made so as to obviate the possibility of the bolt being lost by mounted troops.

The barrel is rather smaller in external diameter and five inches shorter than that of the existing rifle—i. e., 25.2 inches long instead of 30.2 inches.† The fore-sight block carries a barley-corn, which is adjusted before issue, so as to suit the shooting of the rifle. Hitherto the sighting of all rifles of one pattern has been determined by trials of a number of that pattern, whereby the best average position of the fore-sight has been ascertained, and then all rifles of that pattern have had their fore-sights (which were not adjustable) accurately manufactured in that position; this has been insured by careful gauging, but the correctness of the sighting of each rifle has not been tested by shooting. As, however, the shooting of every rifle of one pattern is not identical, it has been decided that in future each rifle before issue is to have its sight tested by firing, and adjusted by the use of suitable barley-corns. High and low barley-corns differ from the normal by .015 inch.

The back-sight (which is very similar to that of the Krag-Jorgensen rifle) consists of a leaf pivoted to the front end of the bed; it is raised by moving the slide which rests on curved ramps, and which is held in position by catches which engage in a toothed rack on each side of the leaf; the rack allows of the sight being set for every 50 yards from 200 to 2000. The catches are released by studs made of bone, so that they can be handled however hot the rifle may be. The V is a small one, as that was generally preferred after trials of different shape. A pair of ears, or lugs, is provided, so as to protect the cap of the back-sight. This cap is capable of a fine adjustment, by means of which any elevation intermediate between the 50-yard intervals can be given; the graduations of the fine adjustment fitting are equivalent to six inches on a vertical target at 100 yards range. There is a wind-gauge with similar graduations. A dial sight is provided, ranging from 1600 to 2800 yards.

The bolt and body are generally similar to those of the Lee-Enfield rifle, except for the fittings for charger loading alluded to above, the abolition of the bolt cover and of the extension for the safety catch. The bolt handle is set closer to the body than formerly. A slot cut in the bolt-head acts as a key when stripping and assembling the striker and cocking-piece, and the bolt can thus be stripped without the aid of tools.

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*After trials of a new pattern rifle of the usual length, and with the Mauser magazine system and charger loading, the United States have decided to adopt as an universal arm, a rifle of that nature, but with a 24-inch barrel, in place of their present Krag-Jorgensen rifle. It is understood that this conclusion has been come to partly on account of their experience in the Philippines and partly from a study of the war in South Africa.

† The barrel of the cavalry carbine is 21 inches long.

The trigger is so constructed as to give a double or drag pull-off, the total pull being 5 to 6 lbs., of which the first pull is from 3 to 4 lbs.

The butt plate is of steel, and there is no butt trap. The cleaning material is carried on the man's equipment.

A nose-cap is attached to the fore end and carries two high wings to protect the fore-sight, and an extension on which the bayonet fixes; this latter is, therefore, not attached directly to the barrel.

The stock is divided into butt and fore end. Butts of three lengths (half an inch difference between each size) are used; they are secured by a stock bolt which is prevented from unscrewing by a keeper plate on the fore end. The fore end and a long hand-guard completely cover the barrel, except where the sights are attached, so that it can be easily handled when hot.

Special care has been taken to keep the barrel free in the fore end, and not to allow it to be gripped tightly by the stock or bands, as, if gripped, the shooting may be seriously affected.

Except for the above points and a few minor details, the fittings are similar to those of the Lee-Enfield rifle Mark I.†

The following are some of the chief particulars:

Length of barrel	25$\frac{3}{16}$ inches.
Caliber	.303 inch.
Rifling	Enfield.
Grooves, number	5.
Width of lands	.0936 inch.
Twist, left-handed	1 turn in 10 inches.
Distance between barleycorn and back sight V	1 foot 7$\frac{3}{16}$ inches.
Length of rifle	3 feet 8$\frac{9}{16}$ inches.
Length of rifle with sword bayonet	4 feet 8$\frac{11}{16}$ inches.
Weight of rifle, magazine empty	8 lbs. 2$\frac{1}{8}$ ozs.

The sword bayonet differs from the existing pattern in the fittings for attachment to the rifle; it weighs 1 lb. ½ oz., and its blade is 12½ inches long.

The charger is made of steel, and is larger than that for the rimless Mauser cartridges.

BALLISTIC AND OTHER TRIALS OF SHORT RIFLE.

The mean muzzle velocity of the shortened rifle is 2025 foot-seconds, or about 30 foot-seconds greater than that of the other rifle. Prolonged accuracy trials have shown that when fired from the shoulder there is very little to choose in point of accuracy between the shortened rifle and the Lee-Enfield. The following were some of the figures of merit obtained:

Figure of Merit (in feet).

Mean of 12 Rifles.

	500 yards.	600 yards.	1000 yards.	1500 yards.	1700 yards.
	feet.	feet.	feet.	feet.	feet.
Short Rifles	.67	.65	1.89	3.75	5.79
Lee-Enfield Mark I*	.62	.74	1.72	4.43	5.88

On a different occasion mean figures of merit of .59 foot and .67 foot respectively were obtained at 600 yards in a covered range with six specially selected .256-inch Mannlichers and six specially selected .276-inch Mausers.

In another series of trials, the following figures of merit have been obtained, all the rifles being fired under the same conditions:

Rifle.	Caliber.	*Figure of Merit.* At 500 yards.	At 1000 yards.	At 1830 yards.
	inches.	feet.	feet.	feet.
Lee-Enfield*.....	.303	.32	1.39	2.32
German service Mauser 1898 Model....	.311	.77	1.52	4.02
Belgian Mauser Rifle.	.276	.89	2.48	5.89
French Lobel.....	.315	.58	1.29	3.42
Italian Mannlicher..	.256	.73	2.04	3.04
U. S. A. Krag-Jorgensen.....	.3	.41	—	—

After firing 10,000 rounds from one of the short barrels it gave a figure of merit at 600 yards only slightly inferior to that of a new barrel. There was, of course, a fall of velocity.

The following is an abstract of some of the results obtained by (a) two highly trained men, (b) two ordinarily trained men, when using single loading and charger loading; one minute was allowed for each series; ammunition in bandoliers in each case.

I. *Distance*, 100 *yards*; *Position*, *standing*; *Target* 3rd *class*.

Firers.	——Single loading—— Average numbers of			——Charger loading—— Average numbers of		
	Rounds fired.	Hits obtained	Points obtained	Rounds fired.	Hits obtained	Points obtained.
Highly trained	11.5	10	28	23	21.5	55
Ordinarily trained.....	10.5	9.5	26	19	14.5	35.5

II. *Distance*, 200 *yards*; *Position kneeling*; *Target*, 3rd *class*.

Highly trained	14	12	28.5	22	18	44
Ordinarily trained.....	10.5	6.5	14.0	17	12.5	31.5

III. *Distance*, 500 *yards*; *Position*, *lying*; *Target*, 2nd *class*.

Highly trained	11	9.5	28	16	14.5	40
Ordinarily trained.....	9.5	7	17	15	10.5	29

The recoils of the new and old rifles have been measured by the Gunmakers' Association, London, as 13.4 foot-lbs. and 11.9 foot-lbs. respectively. (That of a shot-gun weighing 7 lbs. is about 24 lbs.

As regards strength, every rifle with its action assembled has to stand a proof charge giving a pressure of betwen 20 and 21½ tons per square inch; the maximum pressure which the ammunition is allowed to give at proof is 17 tons. The rifle has besides been found to stand repeated pressures of 22 tons, and the body and bolt have not been damaged by repeated pressures of 29 tons.

The action of the new rifle has passed successfully through severe dust and rust trials, and its general serviceability is perhaps best attested by the fact that, besides its trials in Somaliland, it is practically the same as that of the service rifle which was introduced in 1888, and which, besides minor operations, has passed successfully through Indian North-west frontier operations of 1895 and 1897, the Atbara-Omdurman campaign of 1898, and the South African war.—*United Service Institution.*

*This was the long rifle; as stated above, there is little to choose between it and the short rifle.

JAPANESE NAVAL GUNS.—Japanese guns, at least nearly all those of modern pattern, are British in design. Till lately they were imported, but pieces up to 8-inch are now made in Japan, on British models.

The standard battleship gun is the 12-inch Elswick of 40 calibers. It has an initial velocity of 2423 foot-seconds, an energy of 34,600 foot-tons at the muzzle, and fires an 850-lb. shot. Weight, 49 tons. All the first and second-class battleships have this gun.

The 8-inch is a rapid firer, Elswick pattern, 40 calibers long, maximum velocity 2242 foot-seconds with a 210-lb. projectile, and 2068 foot-seconds with a 250-lb. one. Energies, 7219 and 7413 foot-tons respectively. The gun weighs 15½ tons, and is mounted in all the armored cruisers—a similar piece, Italian-built on Elswick lines, being on the Nisshin and Kasuga. It is also on three of the Takasago class.

The standard 6-inch is the 40-caliber Elswick with 2500 foot-seconds velocity, weighing 6½ tons; though some of the older ships have a 6-ton gun of 2250 foot-seconds only.

Protected cruisers carry an Elswick 4.7 of 40 calibers and 2150 foot-seconds. Old cruisers like the Matsushima have a 32-caliber 4.7 of 1938 foot-seconds. It weighs 1 2-3 tons, the later piece weighing 2 tons. The 4.7 is now discarded for new ships.

The new cruisers Niitaka and Tsushima carry a Vickers model 6-inch of 50 calibers. Its velocity with nitro-cellulose is 3000, its energy 6240, and it weighs 8 tons. The nominal penetrations of these pieces, firing capped A. P. shot against K. C. armor at 3000 yards, are:

	Capped.	Uncapped.
12-inch	15½	12½
8-inch	7½	6
6-inch 50 calibers	6½	5
6-inch 40 calibers	4½	4

There are also in the Japanese service an old but very powerful 12.6 Canet gun, equal to 16 inches K. C. at 3000 yards. This is carried by the Matsushima class. The only better gun in the United States navy is the piece carried by the Maine class, but the 13-inch of the Alabama is nearly equal to it.

The Kasuga carried a powerful 10-inch of 45 calibers, with a velocity of 2710 foot-seconds and 25,000 foot-tons odd muzzle energy. It is equal to the 35-caliber 12-inch gun of the Russian battleships. It is of Elswick pattern.

There are four old 12-inch Krupps in the Chen Yuen, but these are weak pieces, no better than the 8-inch in penetrative power. Some old Krupp 10-inch also exist, but they cannot penetrate more than a 6-inch plate of modern make.

Japanese ships have electric hoists and the Barr and Stroud range finders and transmitters.

The normal Japanese shooting is not very good, but of late immense pains have been taken with it, and considerable improvements have resulted.

The 3-inch rapid-fire gun, which enters so largely into the armament of Japanese ships, is shown in one of our illustrations. It is an Elswick gun, and the pattern that is at present in their navy is a 40-caliber piece, firing a 12-pound shell with a velocity of 2200 foot-seconds, and an initial energy of 420 foot-tons. This gun, however, is made in 45 and 50-caliber lengths, and it is one of these that is shown in our illustration, mounted on a pedestal and protected by a shield.

The 3-inch rapid-fire field gun of the Vickers-Maxim make is a compact and efficient piece, which is used for landing purposes. The gun slides in a cradle provided with trunnions, which rest in trunnion bearings in the top part of the trail. The cradle is provided with two hydraulic buffers, in which work pistons attached to a projection on the under

side of the breech of the gun. Inside the cylinders are strong springs, which cause the gun, after firing, to return to battery without any blow or rebound, and without causing any alteration to the elevation or training. It is this feature, coupled with the rapid action and simplified breech mechanism, that gives to this piece its rapid-fire qualities. The trail is fitted with a shoe and an eye for limbering up; and track shoes, shown in the illustrations, are attached by steel-wire ropes to the sides of the trail. The shoes, acting with the spade piece, at the rear end of the trail, which is driven into the ground, serve to prevent the recoil of the cartridge itself. At the extreme end of the trail is an eye for coupling up the gun at the limber.

An important element among the smaller naval guns is the Maxim rifle-caliber gun, which is mounted on the bridges and in the fighting tops, and is also provided with a combined carriage and tripod for landing purposes. The gun, as shown in our illustration, consists of two portions, the recoiling and the non-recoiling. The recoiling portion includes the barrel and the firing mechanism, which move to and fro upon guides attached to the frame, the energy of the recoil being taken up and regulated by means of a spring. The non-recoiling portion consists of the frame and the water-jacket, which latter serves to cool off the barrel during firing. The gun is entirely automatic in its action, being fed with cartridges from a belt, and the firing is controlled at will by pressure applied to the trigger lever in the rear. The gun will fire at the rate of 600 shots a minute as long as any cartridges are left in the belt.

It will be seen that while the ballistics, as given above, of the Japanese guns at present mounted in their navy, are about up to the average, compared with the naval guns of other nations at present in service, they are below the ballistics of the latest types that are being mounted in the new ships of our own and other navies. As a matter of fact, the Japanese have suffered somewhat, in respect of the energy of their gun-fire, from their intimate connection with the British gun makers, whose pieces, particularly those mounted during the past decade, in the British navy, have fallen sensibly behind the Krupp and Creusot artillery in velocities and energies.

The piece that will form the principapl batteries in the new 16,400-ton battleships just ordered from Vickers-Maxim and Armstrong will be considerably more powerful than the present Japanese guns. Thus, the Elswick 12-inch piece of 50 calibers length weighs 65.2 tons, fires an 850-lb. projectile with a muzzle velocity of 2880 foot-seconds and muzzle energy of 48,000 foot-tons; and their 50-caliber 10-inch piece fires a 500-lb. projectile with a muzzle velocity of 2850 foot-seconds, and a muzzle energy of 28,161 foot-tons. The ballistics of the new Vickers-Maxim guns are about the same as these. It is probable that the 50-caliber 10-inch piece will be mounted in the two new battleships; but it is scarecly likely that the 50-caliber 12-inch gun will be used, the 45-caliber 12-inch being a more handy gun, although not so powerful. The latter piece weighs 58.5 tons, and fires an 850-lb. projectile, with a velocity of 2730 foot-seconds and an energy of 43,900 foot-tons.—*Scientific American.*

MISCELLANEOUS.

THE TENDENCY OF BATTLESHIP DESIGN.—The introduction in the late eighties of quick-firing guns of medium caliber and of high explosive shell sealed the doom of the old soft-ended type of battleship, unprotected save as to the boilers, machinery and heavy guns. The fact that stability and maneuvering power were endangered by the storm of high explosive shell which would inevitably wreck the defenseless water-line fore and abaft the belt, and the certain destruction which awaited the unfortunate crews

of the secondary guns, necessitated an extension of the armored area. This was first effected by increasing the displacement; but the enormous development of resisting power in armor which resulted partly from improvements in the composition of the steel of which plates were made, and partly from improved processes of manufacture, notably those introduced by Tresidder and Harvey, followed shortly by that due to the late Herr Krupp, contributed still further in this direction. Between the two main types which had hitherto existed, the short-belted English type with well protected heavy gun bases and transverse bulkheads, and the French type with all-round but narrower belts and weakly supported gun positions, a compromise was arrived at, and, generally speaking, the latter-day battleship has had an all-round, or nearly all-round, belt—in the latter case an after bulkhead has been retained—well protected primary guns and gun bases, and medium armor over the secondary guns; the bases of these being usually protected by armored hoists, or, in the case of main deck guns, by an upper belt of medium thickness. Thicknesses of armor range from 6-inch to 12-inch of Krupp, or other steel of like quality, on the belt, reinforced by an armored deck from 2-inch to 3-inch on the slopes, 8-inch to 12-inch on the primary gun position and bases, and 4-inch to 6-inch on the upper belt and over the secondary guns.

Various methods of disposing the guns have obtained. Opinion has finally favored the English disposition of four heavy guns in pairs in fore and aft barbettes in the center line of the ship, the guns themselves being protected by thick steel hoods. In the United States, in a few cases, secondary guns have been superimposed on the heavy gun turrets, an arrangement of doubtful value which has not found imitators. In England the secondary guns have mostly been disposed in casemates, two-thirds on the main deck and one-third on the upper. Very recently—in the King Edward class and in the Mikasa—the main deck secondary guns have been enclosed in a central citadel with traverses between the guns. In France, and elsewhere, however, the tendency has been rather to place these guns in turrets on the upper deck, a few guns only being in casemates on the main deck. Greater protection to the gun bases is undoubtedly to be had where they are mounted on the main deck, and a greater rate of fire is also probably attainable from guns mounted in battery or casemates than from those in turrets. On the other hand, turreted upper deck guns are better protected than casemated guns; and upper deck guns, however protected, can be fought in all weathers, and make very much better shooting than main deck guns, owing to their greater height above the water-line. From the statement made recently by Mr. Pretyman, with reference to alterations in the Warrior and Devonshire classes, it seems clear that the Admiralty have at last come round to the French way of thinking, and have decided to mount secondary guns as high as possible, and in gun houses or small turrets. Where guns of this nature are protected by 6 inches of Krupp armor they may be considered invulnerable even by capped 6-inch projectiles at a range of 3000 yards, and this for direct impact. At an angle they are practically invulnerable at 1500 yards against their own caliber of shot and shell. With direct impact a capped 7.5-inch armor-piercing shell of good quality might be effective up to 5000 yards, but not at an angle. For a gun whose shell at fighting ranges of 4000 to 6000 yards will perforate 6-inch K. C. at an angle up to 30 degrees, we must turn to the 9.2-inch or similar gun of recent design. The only value of the 6-inch is as a shell gun, and as such even it is ineffective against as little as 3 inches of Krupp steel, and nowadays armor of this or greater thickness covers all essential parts of the target.

It is obvious that to cope with the conditions now prevailing, we must turn to a heavier secondary gun. The 7.5-inch is advocated by many, and, it is rumored, may find a place in the new Lord Nelson class. For ourselves, we would rather see a bold advance to the 9.2-inch, which is now, in all except in name, a quick-firing gun, and either as a shell gun

or for perforation, is much in advance of the 7.5-inch. Eight 9.2-inch guns, all mounted singly in turrets on the upper deck, should prove a very efficient secondary armament, and should be more than equal to fourteen 7.5-inch, which would be of approximately the same weight.

In view of the fact that destruction of personnel is more likely to put a ship out of action than damage to materiel, and that discriminating fire is difficult at long ranges, it might even be contended that every 12-inch gun could be advantageously replaced by two 9.2-inch guns. Still, bearing in mind the fact that 12-inch common shell are likely to get through any secondary armor afloat at fighting ranges, and that the destructive effect of a heavy shell of this kind is enormously great, while no belt armor could keep out 12-inch armor-piercing shell at 2000 yards, and in many cases not at 6000 yards, it seems hardly wise to make so drastic an innovation. The tremendous penetrative power of the 12-inch A. P. projectile, indeed, makes it probable that belt armor in future battleships will not be less than at least 12 inches in thickness over the vitals, tapering to 3 inches or 4 inches at bow and stern, reinforced by a protective deck of from 2 inches to 4 inches on the slopes. An upper belt, which need not be more than 5 inches in thickness, is needed amidships, to prevent high explosive shell from being burst immediately over the engine-room gratings, and to protect the bases of the funnels as much as possible, and it should also be continued forward, tapering to 3 inches at the bow. All secondary gun positions should be on the upper deck, and as twin mountings are, for the present at any rate, to be avoided, a satisfactory one having yet to be designed, these should be in single turrets of not less than 7-inch K. C., with armored tubes of the same thickness. For the anti-torpedo boat armament a clear field of view and fire is essential; this should therefore be carried as high as possible and clear of all gear likely to burst a shell. It is open to question whether the 12-pounder is a sufficiently powerful gun to disable an attacking torpedo-boat destroyer. The French employ a 3.9-inch quick-firing gun, with a projectile 30.8 lbs. for this purpose. Probably a high velocity 4-inch would be the best gun for the purpose. The 3-pounder quick-firer is also a most valuable piece of ordnance, both against torpedo attack and for clearing the upper works of a hostile ships, and these guns are of especial value in the fighting tops, where they are well above the smoke from the main and upper deck guns and have a good field of view.

The fighting top is also useful as an observing station, and the wisdom of its abolition, as in the King Edward class, is open to question. It is true that in all recent experience masts have gone early in an action. Still, this points rather to strengthening and stiffening the masts than to reducing them to a mere pole. The main conning tower should have armor 12 inches thick, and should not be encumbered as at present with a bridge, which would probably, as pointed out by Lieutenant A. C. Dewar, R. N., in his recent R. U. S. I. gold medal prize essay, carry away and foul in action. A secondary conning position with 7-inch K. C. is also needed. A sea speed of not less than 16 knots is essential, and sufficient coal must be carried to give an 8000 miles radius of action.

A battleship designed on the lines here advocated should be possible on a displacement of 16,000 tons, which would appear to be the limit of size at present.

To sum up, our proposed battleship would have the following characteristics:

Displacement	**16,000 tons.**
Speed (sea)	**16 knots.**
Radius of action at 10 knots	**8000 nautical miles.**
Armament	**Four 12 in. in two hooded barbettes.**
	Eight 9.2 in. in single turrets on upper deck.
	20-30 small quick-firing guns (3 in. or 4 in. and 3-pounder).
	Four torpedo tubes (submerged).

Armor—	
Main belt	12 in. K. C., tapering to 3 in. at ends, depth 12 ft. (5 ft. above water-line).
Armored deck	2 in. to 3 in. on slopes, 1 in. on flat.
Splinter deck at top of belt	1 in. on flat.
Upper belt	5 in. 6 in. K. C., tapering to 3 in. forward, depth about 7 ft.
12 in. gun bases and barbettes	12 in. K. C.
12 in. hoods	8 in. front (sloped) to 4 in. at back.
9.2 in. gun turrets	7 in. K. C.
Ammunition hoists to same	7 in. K. C.
Conning towers	12 in. K. C. and 7 in. K. C.

—*Engineer.*

"SCOUTS" AND THEIR CRITICS.—Within a few days of the recent launch of the Sentinel, which is the first of the eight "scouts" to take the water, a vigorous denunciation of this new type of vessel appeared in the *Times*. This article was evidently penned by a capable expert, but it is somewhat unfortunate that its publication should have been postponed until the eleventh hour. New types are always liable to fail in one or more important attributes, and it would be as premature to claim success for the Sentinel class as it is, in our judgment, to condemn them at this stage. The *Times* has certainly indicated some reasons for apprehending that the type may prove unsatisfactory and needlessly costly, and many will agree that it would have been cheaper to have experimented with two or four vessels of the class, instead of eight. It may prove, however, that the courage of Lord Selborne's board in this matter was justified, and we certainly consider that judgment should be suspended until the vessels have undergone some amount of trial with the fleets.

The general characteristics of this new type have previously been described in our columns. The eight units are not identical in structure, some discretion having been left to the architects of the distinguished private firms to which the building has been entrusted. Speaking generally, they are unprotected cruisers of 2800 tons, designed for a maximum speed of 25 knots. At load draft they must be able to stow 150 tons of coal. Among other conditions imposed by the Admiralty upon the builders were that they should be capable of maintaing their full speed for eight hours, and should have a radius of 3000 sea miles at the speed of ten knots. The armament is to consist of ten 12-pounders and eight 3-pounder Q. F. guns, and this, of course, is vastly inferior to the average armament of a gunboat. Upon this weakness—if weakness it should be considered—the *Times* has laid stress, and it must be admitted that the "scouts" are not designed to fight any vessel larger than a destroyer. Their avowed function is scouting, and, when they fall in with cruisers, even of the smallest class, they will have to run. The cost slightly varies, but the average will be £275,000 for each of these "scouts." The *Times* indictment is largely based upon estimates of coal consumption, which may, or may not, prove accurate. It is admitted that the "scouts" will be able to carry far more than the official load draft minimum of 150 tons, although by so doing their speed will necessarily be reduced. It seems hardly possible to work out accurately the effect of an additional 100 tons of coal upon the speed. If obliged to steam at full speed for eight hours, the load draft minimum would be exhausted. But this simple fact must have been clearly foreseen at the Admiralty, and we may, therefore, assume with some confidence that the question of coal endurance was carefully settled before the designs were put to contract.

The writer in the *Times* admits that there is one operation of warfare—viz., blockade—for which these "scouts" of limited radius may be found valuable. There is much in Lieutenant Dewar's prize essay to support this view. He argues that close blockade will rarely be possible, and that

the blockading fleet of battleships should lie at a secondary base, when possible, distant about 120 miles from the port to be watched. The point is discussed with great force, and if the gold medallist be correct in this view, it follows that a special class of swift "scout" is likely to prove of great service to the admiral conducting this form of blockade. Given four or more of these sea gallopers, the admiral could depend upon obtaining information with far greater rapidity than would often be possible by the use of destroyers or ordinary cruisers. Destroyers are used for scouting, but it is not their function. In bad weather their speed is much reduced, and they become liable to capture by larger craft. The "scouts" will be entirely exempt from this risk if able to maintain their superior speed in all weathers. It is, no doubt, a debatable point whether special "scouts" are indispensable or not, and the critic essays to show that ocean liners would do equally well, and could be more strongly armed. What, however, is the cost of an ocean liner able to steam twenty-five knots? Two such vessels have recently been subsidized for Admiralty purposes, and are practically being built at the expense of the country. Even six "scouts" of the mail-steamer type would be a very costly luxury.

The "scout" class, a trenchant criticism of which appeared in the *Times* recently, have formed the subject of some questions in Parliament by Sir J. Colomb. The questions were in one way useful, as they enabled Mr. Pretyman to correct an inaccuracy in a previous reply of his on the same subject. It seems that the full bunker capacity of these vessels is 485 tons, but on the contractors' trial they are only required to carry 105 tons. The writer of the *Times* article, in a further communication to that paper, points out very pertinently that if any one in the public press were to state that a vessel steaming at 25 knots with 150 tons of coal on board could maintain that speed with three times that amount of fuel in her bunkers, he would be open to the charge of making a very bad mistake. The whole secret of the confusion lies apparently with the navy estimates, which, under the heading of "Coal Capacity at Load Draft," gives 150 tons, and further states that the "estimated speed at load draft, smooth water, clean bottoms," is to be 25 knots. These figures are given for all the eight vessels which are already in hand. According to Mr. Pretyman's latest reply, however, when carrying their full load of coal, the "scouts" are only expected to make 24.6 knots.—*Army and Navy Gazette.*

There is a strong opinion that one result of the naval war in the Far East is likely to be a reconsideration of the armament of our battleships. Practically all the engagements by the Russian and Japanese ships have been at long range, and thus guns of high caliber have been more effective than moderate sized weapons capable of attaining high rates of fire. These latter must, of course, be always desirable, because occasions arise when it is of the highest importance to get in as many shots within a given time as possible. But the primary consideration, it would seem, must be the maximum muzzle energy from the greatest number of guns consistent with as high a rate of fire as possible. The 6-inch quick-firer, which has hitherto been regarded with so much favor for the secondary armament of our battleships, can no longer be accepted as satisfactory. For many of the engagements the 6-inch gun proved deficient in range, and could not be used, so that the ships had to depend entirely upon their 12-inch breech-loaders.

It is rather noteworthy that in the two Chilean ships which were bought by our Admiralty, and have since become the Triumph and Swiftsure, this point was anticipated, and the secondary guns are of 7.5-inch caliber, and therefore have about double the striking energy of the 6-inch weapons. In the King Edward class there are four 9.2-inch as well as four 12-inch weapons; in addition there are mounted on the broadside ten 6-inch quick-firers, and it is a subject for serious consideration whether these

6-inch guns should not be discarded, and the weight thus saved be utilized for mounting a fewer number of guns of greater power. To increase the number of 9.2-inch weapons would involve extensive structural alterations, as their mountings are of considerable weight, and might necessitate barbettes or turrets, but were 7.5-inch guns to be fitted within the existing central battery, as in the Triumph and Swiftsure, there would be a material improvement in the gun power with very little change in the structural arrangements of the ships, several of which are in an advanced state. The work in connection with the new design of this year's battleships is proceeding on such lines, and although it is still too early to learn definite details, it may be accepted that what may be termed the primary battery will predominate over the secondary battery to a greater extent than in preceding ships.—*United Service Gazette.*

NAVAL EXPENDITURE.—The following return [129] of naval expenditure of this country in the years 1880, 1890, 1901, 1902 and 1903, and of the naval expenditure of France, Russia, Germany and America in the same years, was issued on May 12 as a Parliamentary paper:

Year.	Great Britain.		France.	Russia.	Germany.	America.
	Estimated.	Expended.				
	£	£	£	£	£	£
1880..	10,702,935	10,513,469	Information not obtainable.			
1890..	19,415,682†	17,042,182†	8,125,929	4,268,208	3,938,869	4,627,203
1900..	32,570,014†	32,131,062†	12,511,054	10,962,801*	7,472,656	13,385,574
1901..	33,824,515†	33,726,491†	13,107,701	11,659,766*	9,624,956	16,012,438
1902..	35,062,904†	34,201,994†	12,271,948	10,667,983	10,029,063	16,293,916
1903..	39,134,887†	39,060,887†	12,538,861	12,349,567	10,252,014	16,824,058

The figures for France, Russia, Germany and America are taken from the estimates of the respective countries, information as to actual expenditure not being available. The estimated expenditure for Great Britain is, therefore, given to enable a comparison to be made.—*United Service Institution.*

TORPEDO ATTACK.—It appeared last week as if we were at last to have that "object lesson" in modern naval warfare which experts and amateurs were so sure about when war was, for the first time, commenced between two powers with modern well equipped fleets. The ill-fortune which has attended the Russian arms from the beginning has not left them yet; and though the Muscovite squadron of three battleships and four cruisers accomplished on June 23 what had been considered the impossible feat of getting out of Port Arthur, they were denied the satisfaction of even striking a blow at their opponents. It is a curious fact that the war between China and Japan of ten years ago—when the latter power had not a battleship to oppose to her enemy—should have been more fruitful in instruction for the naval tactician than the present war, when both sides are possessed of powerful ships. This is to be attributed to the prompt way in which the ever-practical Japanese took the initiative, and, before the Russians were ready, struck a blow which at once made the balance of naval power so unequal that the Russians were more than justified in avoiding battle.

Whatever one's political leanings may be, one cannot but sympathize

*Includes one-fifth of a sum of £11,500,000, which was a special grant sanctioned in 1897 for new construction to be spread over a period of five years. The details of this expenditure have not been published.

†These figures include sums provided under the Naval Defence Act of 1889 and the Naval Works Acts, 1895-1903, inclusive. The figures relating to the years 1901-3 also include the annuities in repayment of capital expenditure under the Naval Works Acts, namely: 1901, £122,235; 1902, £297,895; 1903, £502,010.

with the Russian officers and men in the humiliation to which they have been subjected; the more bitter because it has come from the hands of a foe previously despised. If it be true, as stated, that the ships which came out of Port Arthur, only to be driven back ingloriously, were simply trying to escape, being unable even to defend themselves through having landed a large part of their armament for the purpose of land defense, the situation must have been even more trying. Though the Japanese fleet possessed a decided superiority, such as could hardly have left the issue in doubt, one can understand the disappointment and vexation of a courageous people at being driven helplessly without the ability to strike a blow in defense, and ultimately to be attacked with such disastrous results by the exasperating torpedo craft.

Although this Russo-Japanese conflict, like the Spanish-American war, has yielded no lessons of a comprehensive nature in regard to fleet tactics, yet it is not without its suggestiveness. The great feature has been the efficiency of the torpedo, both in its stationary form as a mine, or when projected from craft in its locomotive character. It has always been recognized that it was a weapon of immense possibilities, and we see now under what conditions these possibilities may be translated into fact. The first attack of last February, when two Russian battleships and a cruiser were put out of action, brought home to us a fact always recognized—the need for vigilance. But, although this was a matter never in doubt, the lesson may be well taken to heart by a people, like ourselves, somewhat over-given to undervalue our foe, and to trust to the valor of our sailors and soldiers, or our own good fortune, to prevent disaster. Although the Russians must have known that war was imminent, they had no idea that the attack would come so soon. The moral is that anything physically possible should be provided against; and that diplomacy may give place to arms at very short notice. Japan displayed exemplary patience up to a certain point; but when she struck she struck suddenly. The example thus set, and its advantages manifested, may be improved upon in the future.

The operations of last week are more fruitful in instruction than those of the opening of the war. Here we have two torpedo-boat attacks carried out under very different conditions. An attempt was made by the Japanese destroyers to attack the Russian squadron as it came out of Port Arthur in broad daylight. This led to an engagement between the Russian and Japanese destroyers, the cruiser Novik assisting the former. As might have been expected, the attack was repulsed; but even had the Japanese destroyers overcome those of their enemy, it is difficult to imagine they could have done much damage to the Russian cruisers and battleships, supposing, of course, the latter to have their proper secondary armament for use. Nevertheless, one Russian ship was hit and took fire, having to retreat into the harbor. What was the description of the "ship" thus put out of action we are not informed. Probably it was one of the destroyers, as a Japanese telegram says a Russian destroyer was disabled, though at what period is not stated.

The way being thus cleared, the Russian squadron proceeded to sea, to be soon driven back to its port. In view of the operations it is difficult to imagine what object the Russian admiral had in putting to sea at all, except for the purpose of escape, so that the fleet might still be available in the case of Port Arthur falling. The superior speed of the Japanese vessels prevented this. The second torpedo attack was of a more instructive nature, although no very certain conclusions can be drawn until we have fuller details than are contained in the telegrams up to now received.

It was 8 o'clock in the evening when the Russian admiral turned back for Port Arthur, and it was shortly after this that Admiral Togo signalled to his destroyers to go in and attack. Their onslaught threw the Russian

line out of alignment, but the ships continued on their course towards Port Arthur. Owing to the obstructions which the Japanese had succeeded from time to time in placing in the entrance to the harbor, the Russian ships had difficulty in entering, and they therefore anchored outside. This may have been a necessity, but it was a direct inducement to the Japanese destroyers to renew the attack, which they did throughout the night. "In spite of searchlights, in spite of mines," the *Times* telegram states, "the destroyers threw themselves upon the Russians, and succeeded in sinking the Peresviet and in damaging the Diana and Sevastopol." The former is a battleship of 12,674 tons displacement, built at St. Petersburg in 1901. The Sevastopol is also a battleship, built at St. Petersburg, of nearly 11,000 tons displacement. The Diana is a cruiser of 6630 tons, also built at St. Petersburg.

That a torpedo-boat attack made during a moonlight night on a fleet thoroughly on the alert should prove so successful is an event that few gunnery officers would have anticipated; and even now there probably will not be many British officers who would acknowledge that such an event would be at all probable if the attack should be against ships of the Royal navy. This conviction might, however, be due to that overconfidence in their own particular weapon which gunnery officers sometimes display; but unless it can be shown that there was something radically wrong with the Russian ships, we shall have to modify our views as to the torpedo being so exclusively a weapon of surprise as has been hitherto generally thought. The impetuosity and persistence of the Japanese attack accounts for its success. Admiral Togo's reports states that the torpedo craft went in eight times. In spite of this they appear to have had few casualties. Admiral Togo's report says: "On our side destroyer Shirakumo's ward room damaged, three men killed, one surgeon and two men wounded. Torpedo boat Chidori received one shot aft engine room, but no casualties. Torpedo boats 64 and 66 slightly damaged." A later telegram states that "a third Japanese torpedo boat, No. 53, was damaged."

That so little damage was done to the Japanese vessels after eight attacks on a prepared fleet argues that the conditions were not what could be described as normal, and we must not take the result of this engagement to be a measure of the efficiency of the torpedo. No doubt in the fullness of time, when we get a detailed account of this action, naval officers will find many points of interest and instruction, both from the point of view of attack and defense; but until such information arrives it is not possible to arrive at any definite conclusion.

There is one other matter of interest connected with this sortie of the Russian fleet. It was only a day before the news arrived that the ships had put to sea that an account appeared in the papers, from what was described as a trustworthy source, that it was impossible for the ships which were torpedoed in February to have been repaired at Port Arthur, owing to the extensive nature of the damage and the lack of facilities at the port; yet we see these vessels issuing forth capable of making a comparatively long run on their own steam. The fact must reflect great credit on the perseverance and resources of Russian engineers, for there is little doubt the ships were badly damaged. When the full account of the war comes to be written, no chapter will be more interesting and instructive than that giving the extent to which the vessels were injured by torpedo explosions, and the manner in which repairs were executed. Whether such information will modify to any considerable extent the design and construction of war vessels, is a doubtful problem. At any rate, all suggestions that have been made up to the present for protecting ships against torpedo attack have been of a nature that the majority of experts have considered impracticable. The torpedo-net has fallen into disfavor as being ineffective, and an armored bottom is considered of doubtful utility, even if it were advisable to devote sufficient displace-

ment to such a means of defense. The extensive damage due to torpedo explosion renders cellular structure a difficult problem; though if such a means were adopted, care should be taken to make the connections as flexible as possible. The grounding of the Apollo some years ago gave a valuable object lesson in this direction.—*Engineering.*

ELECTRICITY AT THE WASHINGTON NAVY YARD.

BY J. E. PRICE.

The biggest job of its kind in the world is now on foot at the Washington navy yard. This is the work of equipping the gun lathes in the big gun shop with electric drives, and making other improvements with electric outfits, thus supplanting the wilderness of shafting, belting, wheels and other connections of the steam machinery used.

In connection with completing the electric outfitting of the various shops of the navy yard a new power plant is being built. This will furnish power for all the work-shops, excepting the model-making shop, which has a plant of its own, that also furnishes current for operating the towing carriage of the model-testing tank.

The new power-house is 165 feet long by 100 feet wide; it has two brick chimneys, each 204 feet high, and when in use will have a boiler capacity of 6000 horse power. The engine equipment will consist of four 500-kilowatt, 244-volt, direct-current generators, at 120 revolutions per minute, direct-connected to vertical cross-compound engines. One of the improved features of the new power-house will be its method of obtaining water. This will be brought over a distance of 600 feet from the eastern branch of the Potomac River, by gravity through a 36-inch conduit which will lead to a well. The system will be economical, as it will do away with the necessity for suction pipes; and an abundance of water can be had at all times.

The electric plant now in use in the yard is entirely capable for present work, but when the steam-operated machinery gives place to electric movement, the power afforded will not be sufficient. The plant consists of four engines with a combined output of 1325 horse power, two of 300 horse power, cross-compound, Ball & Wood, at 250 revolutions; one tandem-compound, 125 horse power, at 300 revolutions, and one McIntosh & Seymour of 600 horse power, at 130 revolutions. The smaller ones are direct connected to two generators on the Edison three-wire system. The boiler service is equal to about 2500 horse power.

The present electric plant supplies light and power, the number of lights consisting of 6000 incandescent and 450 arc lamps. There are seventeen electrically operated traveling cranes in the shops and 152 motors. The largest crane is of 110 tons capacity; the smallest, 10 tons. Some of the motors are mounted in the galleries and connected to shafting; others, especially in the shops where small fixings are finished, are mounted on or connected at the floor with machines.

Under direction of Mr. C. E. Reid, chief electrician of the navy yard, the work of installing the new apparatus for operating the big gun lathes is being carried on as fast as such a large undertaking could be expected. There are eight of these lathes distributed over the 1000 feet of length of the main gun building shop, and each takes up about fifty feet in distance across the eighty feet of width of the building. These lathes are ponderous and require for movement an aggregate of 850 horse power. By the new arrangement of a multi-voltage system, each lathe will receive current for 56 horse power. The armature of the main driving motor will be mounted on a bronze sleeve which will run on the present cone shaft. A 10-horse power motor will also be employed on each lathe for moving the tool carriages which hold the tools used in gun trimming and polishing.

When the gun shops get their full electrical equipment there will be only three shops in the Washington navy yard not completely outfitted in this respect; but these now have electric cranes and some other electrical features. All shafting will be done away with. The use of belting as still continued, in a number of the shops, has its marked disadvantages. It takes up room that could be otherwise employed; it is in this way causing delay in the movements of men and material; and a particularly objectionable feature of this method of drive is in the fact that when a main belt breaks the whole machine work of the shop must be stopped until repairs are made.

The work of this navy yard has increased to such an extent that now there is not room enough in which to carry all of it under cover. At present work on ammunition hoists is being done out-doors. There is, since the addition to the acreage of the yard, plenty of space for much needed buildings and Congress would hasten the effectiveness of the navy by appropriating for such.

This navy yard is a most important factor in the making of a great navy for this country; from it are sent guns of various sizes (the largest being of 12-inch caliber, 45 feet long), gun carriages, projectiles, ammunition hoists and other finished material.

The Washington navy yard has grown as the navy has grown; and it began almost with the beginning of the navy. Congress on February 25, 1799, appropriated $1,000,000 for building six of the largest ships of war. That the object of this appropriation should be more speedily and economically accomplished, together with the design of creating a permanent navy, the Navy Department in the latter part of the year 1799 proceeded to apply a portion of this amount to the purchase and improvement of selected ground for six navy yards—one each at New York, Philadelphia, Boston, Portsmouth, Norfolk and Washington. The ground for the latter, originally consisting of forty acres, was bought for $4000. A little over a hundred years later, the addition to this land, recently purchased, about forty-five acres, cost $100,000. As early as October, 1801, the Government had expended $54,863 on the yard, and by January 20 of the following year, timber for a 74-gun ship and other material for this yard had been purchased to the amount of $158,685.

So it will be seen that the Washington navy yard began progressing early. But, about this time, the advocates of a good, effective navy for the United States were surprised and angered by the action of Congress and the President. The legislative body passed the Peace Establishment act, among other provisions of which the President was directed to discharge all the naval officers of the United States, except nine captains, thirty-six lieutenants and 150 midshipmen. The number of captains on the active list was twenty-eight. The act also authorized the sale of all ships and vessels belonging to the navy, except thirteen frigates, only six of these to be kept in commission, the remainder to be dismantled and laid up.

When this curious act was passed, Thomas Jefferson was President, and he had a theory that war was unnecessary, and that a powerful navy was a continual challenge to war. Later on, however, the navy and the navy yards began to grow, and to-day, in point of armament and execution, we have the best navy and the best ordnance factory in the world.—*Electrical Review.*

STEAMING POWERS OF THE RUSSIAN AND JAPANESE FLEETS.—At the outbreak of the war we gave some data as to the steaming capacity of the rival warships. Since then the vessels have gone through several months of active service and some particulars as to how they have fared may be of interest. For obvious reasons very exact data are not procurable, and such as are available refer to some six weeks ago. Most interest centers in the Japanese ships, which have been submitted to a very severe test indeed. As might be expected, not a single ship is now able to steam

at its original speed, but in the majority of cases that seems due to absence of docking rather than to machinery and boiler troubles.

Up to the time of her loss the most efficient steamer in the Japanese fleet was the Hatsuse. An officer of hers, writing only a few days before that event, mentioned that no defects of any kind had appeared in her boilers or machinery, and her speed loss from foul bottom was very little—about half a knot. The lame ducks were the Asama, Yoshino, Chitose, Niitaka, Fuji and Yashima. All these except the Niitaka had had boiler troubles, mostly of the "bird-nesting type." Of these all save the Niitaka have cylindrical boilers, in most cases nearing the end of their span of existence. The Niitaka has water-tube boilers of the Niclausse type, and these appear to have worked well. The ship had either been aground or badly hit, and it was not deemed well to press her upon that account. There is some mystery about her.

Loss of water was experienced in the Iwate after an extensive hit during the battle of February 9. Her boilers are of the Belleville type. She would seem to have been hit in the region of the boiler rooms, but her steaming capacity was not affected to any extent, and her own people tightened up the joints that had been sprung.* This ship is at present good for 21 knots. The speed of the Asama has sunk to 18 knots or thereabouts; the other cruisers mentioned are somewhere about the same. The two old battleships were down to something like 14 knots, it being considered unsafe to press their antique boilers. The Mikasa, Asahi, Yakumo, Azuma, Idzumo, were, at the time of our advices, steaming fast and well; their Bellevilles had given no trouble at all, and machinery defects had been of a very mild nature. The Shikishima had had no boiler troubles, but some small injury had been suffered by the machinery—probably from Russian projectiles.

As was only to be expected, the destroyers had one and all fallen off in speed under the tremendous strain put upon them. Data of the speed losses are not procurable, nor is it possible to ascertain how far hostile projectiles are responsible. The general feeling on destroyer performances was not one of dissatisfaction, bearing the circumstances in mind. The best steamers of the lot are the Shiakumo and Asashio.

Only one Russian ship has done much hard steaming—the cruiser Bayan. It was the Bayan which, when she reached Port Arthur a little before the war, came up at full speed, exceeding her contract rate at the end of a long voyage. She was therefore in the pink of condition, and from all accounts has so remained right through the war—an all-round credit to her designer, her builder, her machinery, her boilers and her crew.

The Gromoboi and Rossia are both in good steaming condition, and so is the Askold. This ship has Thornycroft boilers; the others have Belleville.

The Novik has been several times injured, and, having been also hard pressed once or twice, her machinery has been shaken up a good deal. It is doubtful whether she can do 20 knots at present; possibly not more than 18. Her boilers are said to be in a very passable condition.

The Retvizan had her engines thrown out of alignment when she was torpedoed, and her steaming powers are very poor, despite repairs. The shock developed leaky tubes, but the repairs were not very lengthy. One tube is said to have burst.

The Czarevitch suffered no hurt at all to machinery or boilers when torpedoed, and her propellers were untouched, though the torpedo hit her rudder. She is still able to steam at a good speed, the steering gear being the only part of her machinery injured.

The Pallada was hit amidships by a torpedo that came through the side, and exploded partly in a coal bunker and partly right inside one of her group of Belleville generators. The tubes were torn out and bent S shape.

* Another version is that the leaks were in the boiler-room, not in the tubes at all.

They were taken out, straightened and replaced, mostly by her own engineers.

A not very dissimilar hit was received by the Pobieda, which was hit by a mine in the port boiler room. The boilers run the length of the ship instead of athwartships, and this probably did much to save the men in the room concerned. A great deal of water came in and the fires were quenched, but no one was injured, no tubes burst and the ship returned to harbor without assistance under her own steam. In harbor the water was pumped out. No repairs were needed save a patch in the side where the hole was. The main engines were quite uninjured.

The three Poltavas had well-worn boilers when the war began, and none of them seem to have done more than about 12 knots speed. Lying mostly in harbor, the war has put no strain upon them.

In the early days of the war, Russian destroyers were hopelessly outmatched in speed by the Japanese; but the harder service to which the latter have been put has done much to equalize this, and there is little to choose between them now. If anything, the Russians have got better speeds out of their destroyers recently than when the war began, which would seem to indicate that past slackness had much to do with their early failures to steam well with these craft. The fastest Russian destroyer is the Schichau-built Lieutenant Bourakoff.

Speaking generally, the engine room lessons of the war have been as follows:

(1) The impact of heavy projectiles has a strong tendency to affect the alignment of machinery by shock, but less effect than might be expected upon boilers, whether water-tube or cylindrical. Only direct hits seem to have effected the generators.

(2) All small ships, especially torpedo craft, wear out quickly, and lose heavily in speed as the result of hard work.

(3) The deterioration of big ships is considerably less; and in the case of ships which, like the Idzumo and Bayan, were well cared for in the days of peace, very little indeed.

(4) Disablement of machinery by gun fire is quite improbable; partial injury is all that is to be feared.

(5) Cylindrical boilers have proved inferior to water-tubes, or, at any rate, to the Belleville variety, with which most of the water-tube combatants are fitted. The tubes have been easily swept at sea, whereas the cylindrical ships have had to go into harbor continually for cleaning.

(6) It has not been possible to maintain full speed for any length of time in either fleet, though the Bayan is said to have once steamed nine hours at top speed. One cause of failure has been the physical difficulty of getting the coal from the bunkers quickly enough. It is deduced from this that coal economy is even more important tactically than strategically. A fractional difference in consumption per indicated horse power means a good deal of difference in three hours' coal shoveling, where large horse powers are involved. The Bayan in her nine hours' run would certainly have been captured or destroyed had she been unable to keep up the supply of steam. In the majority of the ships engaged, the tendency when full power was wanted was to shovel on coal recklessly. This meant that the boilers were given more coal than they needed, and accelerated physical exhaustion resulted. In the Bayan, firing was done by system and regularly, with the result that less coal was burned, more efficiency per pound secured from it, and the physical exhaustion problem of stoking not felt. The ship has always been remarkable for a low consumption, but the firing signalling system employed undoubtedly bore its share in the paradox that "she steamed away from the enemy by burning less coal than they did!" The most pregnant lesson of the war would seem to be that the all-important qualification for a naval boiler is the giving of the maximum result from every pound of coal. The endurance of the stoker is the rock that lies in the way of keeping up contiguous full speed.

We are indebted for the above particulars to officers in the Far East who are in a position to glean the views of the combatants.—*Engineer.*

A series of interesting experiments with the new war kite for utilization with a newly discovered system of wireless telegraphy were recently carried out with great secrecy before Kaiser Wilhelm. The inventor is a German-American professor, at present residing at Havre. The operations were carried out about a mile from the shore. No spectators whatever, beyond the naval officials and the Emperor and his suite, were allowed to witness the experiments. Seven kites were flown on copper wires to a height of from 10,000 to 12,000 feet. The experiments were partly made from the Kaiser's dispatch boat Sleipner, traveling at the rate of thirty knots an hour, and several languages were employed. The features of the invention is the possibility of transmission over the greatest distances without affecting any other wireless telegraphy station. The form of the kites used is that of two cubes side by side, similar to the Cody box kites.—*Scientific American.*

LARGEST SAILING VESSEL AFLOAT.—The trip of the sailing vessel Preussen, which left its German home a year ago, attracts the liveliest attention.

Generally speaking, the opinion prevails that, on account of the progress made with steamers, sailing ships are doomed. For this reason the results of recent efforts to utilize large sailing vessels in trans-oceanic traffic deserve special mention.

The Preussen has storage room for over 5000 tons of freight. According to reports it has fully justified expectations and furnished prof that sailing vessels are not yet to be left out of the consideration.

The trip from the canal to the Chilean port Iquique, a distance of 12,000 nautical miles, was made in fifty-seven days, a new record for sailing vessels being thereby established. It must be borne in mind that the weather was not always favorable, and that the trip around Cape Horn was extremely tempestuous.

The Paris *Cosmos* remarks, with reference to the voyage of the Preussen, that "if one considers the expenses of this vessel on such a trip, compared with those of a steamer, it becomes evident that sailing vessels will never disappear."

Only two obstacles are met, say German papers, in the employment of big sailing vessels; first, it is hard to secure assurance of a sufficient cargo; and second, it is difficult to secure a crew of sufficient skill. These obstacles are important, because sailing vessels, in order to be able to compete with steam, must be much larger than heretofore.—*Nautical Gazette.*

RECORD FOR HANDLING CARGO.—The advantage of a steamer of modern construction, as compared with some of the older vessels, was thoroughly demonstrated at South Chicago, last Thursday, when the huge steel freighter Augustus B. Wolvin, with her thirty-three hatches, unloaded her cargo of 10,731 gross, or 12,289 net, tons of iron ore in a little more than ten hours. With this immense cargo the Wolvin, which is the largest craft afloat on fresh water, registered less than 20 feet draft. The load of ore was discharged at the docks in the north slip of the Illinois Steel Company, where the Hoover & Mason clamshell hoisting rigs are located. Promptly at 7 a. m. the dock gangs set to work removing the great cargo, and, after allowing half an hour for dinner at noon, the job was completed at 5.30 p. m.

The Wolvin's cargo of ore is the largest ever handled by a single boat on the lakes and would have proved a record breaking load of anything else on other waters up to a few years ago. The record for iron ore cargoes previous to the advent of the Wolvin was held by the steamer William Edenborn, which delivered a cargo of 8807 gross, or 9864 net, tons of ore at South Chicago last year.—*Nautical Gazette.*

Aerial telegraphy is now making considerable progress in France. The Secretary of Posts and Telegraphs decided not long ago to erect two aerial telegraph stations in the neighborhood of Paris. These stations have now been built and equipped with the most recent apparatus, and they have already commenced to operate. One of the stations is placed at Villejuif, in the suburbs, and the other at Melun, at twenty miles from the city. These two posts are to be used mainly for experimental purposes, and are designed to train the technical staff and the operators which will be needed in the future for the stations to be erected along the coast of France, for the government has an extensive coast system in view. Different forms of apparatus and new inventions will be tested here before being finally adopted. At the Villejuif station the current is furnished by a dynamo driven by a gasoline motor and charging a set of accumulators. The Melun plant uses current from the central station mains. The apparatus of both stations has been designed by M. Rochefort and constructed by the Mors Company. As soon as the preliminary tests are made at the two trial stations, it is expected to install the different aerial telegraphy posts along the coast. These will be used to communicate with vessels, both for the marine department and for public use. Up to the present there have been no stations for the public messages, as those which now exist are used exclusively by the marine for signaling to the warships. An agreement was made last year, however, by which the Minister of War is to turn over these stations to the Postal and Telegraph Department, and the latter is to operate them in the future, as well as all the new stations which will be erected. The coast system which will be eventually established is to serve for the use of the War Department as well as for the public. In this way the government expects to gain a decided advantage by using a single system instead of two separate ones, which might conflict with each other, and besides would be more expensive to operate. The first station to be opened to the public will no doubt be those of Ouessant, on the Channel coast, and a second at Porqueralles, and these are to be increased in capacity. The administration is now studying a project of erecting several other stations on the coast in the immediate future. One will no doubt be placed at the Cape of La Hague on the north coast, a second at La Combre, and a third in Corsica, at Ajaccio. As to the apparatus which is now used on the warships considerable progress has now been made in the distance which can be covered, and according to reports the French vessels are breaking all the previous records for distance. The journals state that the foreign warships are not able to signal at greater distances than 115 miles, according to the statements of English and Italian officers. The French battleship Jena, of the Mediterranean squadron, and the cruisers Guichen, of the Atlantic fleet, are able to receive messages at a distance of 195 miles. This result has been considered a record in Europe, but according to the latest news the distance has been still further increased. Not long ago the battleship St. Louis while in the Mediterranean received telegrams sent from Port Vendres on the south coast at a distance of 273 miles. A few weeks before this, while lying in the harbor of Barcelona, the St. Louis took messages which were sent from the battleship Suffren while in the harbor of Toulon, covering a distance of 223 miles.

Another series of experiments is now being carried out in Paris, and the Eiffel Tower is to be used as the central point. This should make a specially good station owing to the great height of the tower. The metallic structure will not, however, be used to form the mast, but it will support a cable or copper wire 350 meters long. At the ground the wire passes into the cabin which is to contain the instruments. With the station thus equipped, and a heavy current which can be taken directly from the city mains, it is expected to signal over the country to distances of two or three hundred miles. The experiments are being carried out by Captain Ferries, of the city engineering corps, aided by the telegraph personnel.

Five of the seven wireless telegraphy stations of Italy will shortly be opened for public messages. Up to the present these have been used exclusively by the government, but the Minister of the Marine recently made an agreement with Marconi regarding the above change, and the public will now have an opportunity to make use of the stations. Two stations have been reserved exclusively for the government; one of these is the Monte Mario station of Rome and the other is in Sardinia. As many as eight new stations will be soon completed, and it is expected that they will be in operation in the latter part of the year. One of these lies near Venice and another is located in Sardinia. They are expected to work over a radius of 200 miles. Besides these stations is the post in the Naval Academy at Leghorn, also the San Vito and the Varignano stations near Spezzia which are controlled by the Navy Department. It is stated that the tariff for the public messages which will be sent and received at the coast stations is 7.50 lire ($1.50) for a message of twelve words.—*Electrical Review.*

REPORT OF THE COMMITTEE ON NAVAL BOILERS.—The committee appointed by the Admiralty to consider the subject of the boilers adopted in navy ships have now completed their investigations, and their final report was issued officially by the Government printers on Wednesday night. We give appended the full text of the report, along with the covering letter by Admiral Sir Compton Domvile, which latter is of even more importance than the report itself:

H. M. S. BULWARK, at Rapallo, June 12, 1904.

SIR: I have the honor to submit herewith, to be laid before the Lords Commissioners of the Admiralty, the final report of the Boiler Committee of which I am the president. Although I have not been present at the experiments carried out during the last two years, I have received from time to time all the reports, and they show the great care and pains taken by the committee to obtain correct results.

2. With reference to our previous report, I am compelled to say that my experience with the Belleville boilers on the Mediterranean station has been very favorable to them as a steam generator, and it is clear to me that the earlier boilers of this description were badly constructed and badly used. We have had no serious boiler defects in any of the ships out here, and the fact that two ships are about to be commissioned with only the ordinary annual repairs being undertaken, shows that their life is not so short as I originally supposed. However, the second commission of these ships will be a very good test of the staying capabilities of their boilers.

3. In conclusion, I cannot express too highly my opinion of the work done by my colleagues on the committee.

I have the honor to be, sir,
Your obedient servant,
(Signed) COMPTON DOMVILE,
Admiral and Commander-in-Chief,
President of the Boiler Committee.

The Secretary to the Admiralty.

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1. The Committee on Naval Boilers, appointed by the Lords Commissioners of the Admiralty in September, 1900, having completed their investigations and experimental trials, and being in a position to recommend standard types of boiler for use in H. M. navy, as requested in their Lordships' letter of February 28, 1901, have the honor to submit their final report.

2. A statement of the work of the committee up to May, 1902, was given in paragraph 2 of their report of that date. Since then the reboilering of H. M. S. Medea with Yarrow large-tube boilers and of H. M. S. Medusa

with Dürr boilers, together with the necessary machinery alterations, have been completed under the supervision of the committee, and the boilers of both ships have been thoroughly tested. The results obtained are recorded in a separate report. As requested by their Lordships in their letter S $\frac{16683}{28331}$ of November 19, 1902, the committee have also carried out a series of trials of the Babcock and Wilcox boilers of H. M. S. Hermes, which extended from October 7, 1903 to May 16, 1904. These trials also form the subject of a separate report.

3. The committee have from time to time reported the results of their investigations, and they have also answered such questions as have been put to them by their Lordships. The reports and other documents which have already been forwarded include:

(*a*) The interim report forwarded on February 19, 1901.*
(*b*) Minutes of the evidence given before the committee, together with the appendix thereto, forwarded April 26, 1901.†
(*c*) Report on the trials of the Hyacinth, Minerva and Saxonia,‡ together with a summary of conclusions, forwarded November 27, 1901.§
(*d*) Progress report for the year 1901, forwarded December 31, 1901.‖
(*e*) Report on the relative economy and efficiency of Belleville and cylindrical boilers in commissioned ships, forwarded April 29, 1902.‖
(*f*) Report of May, 1902, together with the appendix thereto.¶
(*g*) Report on the trials of the Seagull, Sheldrake, Espiègle and Fantôme, forwarded August 5, 1902.**

There are now submitted with this report:

(*h*) Report on the trials of the Medea and Medusa.††
(*i*) Report on the trials of the Hermes.††

4. The report of May, 1902, was intended to be final as regards the Belleville boiler, and the committee have since seen no reason to modify the opinion expressed in paragraph 6 of that report—viz., that it is "undesirable to fit any more of this type in His Majesty's navy.

5. In paragraph 5 of their report of May, 1902, the committee stated that the experience obtained by them since the date of their report of February, 1901, had confirmed them in the opinion that "the advantages of water-tube boilers for naval purposes are so great, chiefly from a military point of view, that, provided a satisfactory type of water-tube boiler be adopted, it would be more suitable for use in His Majesty's navy than the cylindrical type of boiler."

In their reports of 1901 and 1902 the committee expressed the opinion that four different types of water-tube boiler, viz.:

(*a*) Babcock and Wilcox,
(*b*) Niclausse,
(*c*) Dürr, and
(*d*) Yarrow large-tube,

were sufficiently promising to justify their use in His Majesty's navy in combination with cylindrical boilers. Having concluded their experimental investigations, the committee are now satisfied that two of these four types—viz., the Babcock and Wilcox, similar to that tried in the Hermes, and the Yarrow large-tube, similar to that tried in Medea—are satisfactory, and are suitable for use in battleships and cruisers without cylindrical boilers. In the Babcock and Wilcox boiler the generating tubes

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*See ENGINEERING, vol. lxxi., page 335, and also pages 341 and 480; vol. lxxii., page 121; and vol. lxxiii., p. 284.
†The minutes of evidence have not been published.
‡An interem statement by the President of the Committee was published in August, 1901 (see ENGINEERING, vol. lxxii., pages 288 and 291).
§See ENGINEERING, vol. lxxiii, pages 278 and 336, see also 749.
‖These reports were not published.
¶See ENGINEERING, vol. lxxiv., pp. 54 and 90, see also 81.
**Ibid., vol. lxxv., page 79.
††These documents are not included in the report as now issued to the public.

are nearly horizontal; in the Yarrow boiler they are nearly vertical. Each type has its particular advantages, and only long experience on general service can show which is, on the whole, the better boiler. For the present the committee unanimously recommend both types as suitable for naval requirements.

In making these recommendations, the committee recognize that the upkeep of any water-tube boiler is likely to be heavier than that of the cylindrical boiler; but they are of opinion that the two types they now recommend will cost less for upkeep than the other types of large straight-tube boiler which they have had under trial.

6. The committee make these recommendations after investigations and trials carried out under their superintendence extending over a period of nearly four years.

The ships in which each type of boiler has been tried by the committee are:

Cylindrical—H. M. S. Minerva and R. M. S. Saxonia.
Belleville—H. M. S. Diadem and H. M. S. Hyacinth.
Babcock and Wilcox—H. M. S. Sheldrake, H. M. S. Espiègle and H. M. S. Hermes.
Niclausse—H. M. S. Seagull and H. M. S. Fantôme.
Dürr—H. M. S. Medusa.
Yarrow large-tube—H. M. S. Medea.

7. Although the committe have no knowledge of any type of water-tube boiler which is likely to prove more suitable for His Majesty's ships than the two recommended, there are other types which may be considered worthy of trial later on. If any type of boiler is considered, in future, to be of sufficient merit to justify its trial in the navy, it is recommended that it be fitted in a new vessel not smaller than a second-class cruiser.

8. As in their previous reports, the committee do not offer any remarks upon the most suitable type of boiler for small vessels of high speed. From the nature of the case, some form of "express" boiler, with small tubes closely pitched, is absolutely necessary, in order to obtain such a ratio of output to weight of boiler as is required in torpedo boats and destroyers. For small cruisers, however, which have to keep the sea and act with the fleet, it is probable that a boiler such as the Yarrow large-tube would, on the whole, give better results than the "express" types which have hitherto been fitted.

9. In reference to paragraph 3 (*b*) of their Lordships' letter of September 6, 1900, and to the committee's report of May, 1902, they desire to call attention to the breakdown of the Hyacinth's machinery on February 16, 1903, and to the trouble experienced with the bearings in the Hermes during the homeward run from Gibraltar, which strengthen the recommendation of the committee contained in paragraph 13*a* of the report of May, 1902—viz.: "They consider it desirable, where practicable, to increase the length of stroke and reduce the number of revolutions per minute as compared with the recent practice in His Majesty's service."

10. The principal comparative results on which the recommendations of the committee are based are set forth in the succeeding paragraphs. Full details are given in the separate reports of trials.

11. *Thermal Efficiency of Boilers.*—The full tables which are appended to the committee's reports give the efficiency of each type of boiler under very varied conditions. The results are here summarized:

The best obtained with the Babcock and Wilcox boilers of the Hermes were during the trials of furnace gas baffling, the boilers in the middle boiler room, with vertical baffles and a forced air supply over the fires, giving the high efficiency of 81 per cent on a 30 hours' trial, when 20 lbs. of coal were bing burnt per square foot of fire-grate per hour, and an efficiency of 77.8 per cent on a 29 hours' trial when burning 27 lbs. per square foot, these rates of combustion corresponding to the ordinary rate

of steaming and to the full power of the boilers respectively. The boilers of the Hermes with the restricted up-take baffling, and without any special air supply over the fires, had a maximum efficiency of 75.8 per cent on a 12 hours' trial when burning 20.5 lbs. per square foot per hour. On three trials of over 24 hours' duration each, and when 19 lbs. were being burnt per square foot per hour, the efficiency was in each case practically 71 per cent. When burning 29 lbs. per square foot per hour for seven hours, the efficiency of these boilers was 66.3 per cent; but the weather during this test was so bad that the trial, which was to have been of eight hours' duration, had to be stopped on this account after the seventh hour. During the baffling trials, however, in good weather, an efficiency of 70.3 per cent was obtained on the 30 hours' trial, when burning 27 lbs. per square foot per hour, or practically the full output.

The maximum efficiency of the Yarrow boilers of the Medea—viz., 75.7 per cent—was obtained on a 26 hours' trial when burning 18 lbs. per square foot per hour; their efficiency when burning at the maximum rate of combustion—viz., 40 lbs. per square foot per hour for eight hours—was 69.5 per cent. On trials of over 24 hours' duration each, burning from 17 lbs. to 21 lbs. per square foot per hour, the efficiency remained at or over 75 per cent.

The Belleville boilers of the Hyacinth had a maximum efficiency of 77.2 per cent recorded on a 24½ hours' trial, when 16 lbs. of coal were being burnt per square foot of fire-grate per hour. When burning 20 lbs. per square foot per hour for 11 hours, the efficiency was 73.3 per cent, and burning 17.4 lbs. for 24 hours it was 71.8 per cent. The efficiency of these boilers on an eight hours' trial in fine weather, when burning 27 lbs. per square foot per hour, corresponding to the full output of the boiler, was 65 per cent.

The maximum efficiency of the Dürr boilers of the Medusa was 64.8 per cent, obtained on an eight hours' trial, when burning 35 lbs. per square foot per hour, this being the maximum rate of combustion with these boilers; the efficiency when burning 16 lbs. per square foot per hour for 26 hours was 63.8 per cent. On trials of over 24 hours' duration each, and burning 18 lbs. and 21 lbs. per square foot, the efficiencies were 61.7 per cent and 60.3 per cent respectively.

Of the cylindrical boilers tried, those of the Saxonia on the only trial made, which was of 13 hours' duration, and on which 20 lbs. per square foot per hour was burnt, had the high efficiency of 82.3 per cent.

The maximum efficiency obtained with the cylindrical boilers of the Minerva was 69.7 per cent, which was recorded on a 25 hours' trial when burning 14 lbs. per square foot per hour; on a trial of 8½ hours' duration, with retarders in the plain tubes, and burning 29 lbs. per square foot, the efficiency was 68.4 per cent.

In the smaller ships, the maximum efficiency of the Babcock and Wilcox boilers tried was 66 per cent on a 12 hours' trial, burning 18 lbs. per square foot per hour in the Sheldrake, and 73.2 per cent on a nine hours' trial, burning 13 lbs. per square foot, in the Espiègle. The maximum efficiency obtained by the Niclausse boilers of the Seagull was 66.9 per cent on an eight hours' trial, burning 13 lbs. per square foot, and by those of the Fantôme 69.8 per cent on a nine hours' trial, burning 14 lbs. per square foot.

12. A noticeable feature in connection with the boiler efficiencies is the improvement in the results obtained with the later boilers of the Babcock and Wilcox type. The earliest of these, fitted in the Sheldrake in 1898, showed efficiencies ranging from 66 per cent to 59.2 per cent; the boilers fitted in the Espiègle in 1901 showed improved efficiencies, ranging from 73.2 per cent to 63.1 per cent. Those of the Hermes, fitted in 1903, show a still further gain in economy, the efficiencies ranging from 75.8 per cent to 66.3 per cent, and the same boilers, after modification, showed on one occasion the high efficiency of 81 per cent. It is noticed in this connection that the three sets of Babcock and Wilcox boilers tried differ from each

other in the arrangement of their heating surface and furnace gas baffling. The boilers of the Sheldrake were fitted throughout with tubes 1 13-16 inches in diameter, without any baffles for furnace gases; the boilers of the Espiègle were fitted throughout with tubes 3 3-16 inches in diameter, vertical baffles being placed among the tubes, and causing a zigzag flow of the gases; the boilers of the Hermes were fitted with two rows of 3 15-16 inch diameter tubes, immediately over the fire, the remainder of the tubes being 1 13-16 inches in diameter, and the baffling of the furnace gases was effected by a restriction of the space for the passage of the gases between the top row of tubes. Those boilers of the Hermes which showed the efficiency of 81 per cent were similar in construction to those last mentioned, but the baffling of the furnace gases was by a vertical system which caused a zigzag flow of the gases over the heating surface, and, in addition, a forced air supply was introduced above the fires. (See "Report on Trials of H. M. S. Hermes.")

The arrangement of the heating surface in both the earlier and later boilers of the Niclausse type was the same, and the thermal efficiencies of the two sets of boilers were very similar.

13. *Wetness of Steam.*—As explained in other reports, the wetness of the steam was taken throughout the committee's trials by means of a Carpenter's calorimeter. Experience in the Medusa satisfied the committee that the results registered by this instrument are trustworthy.

As regards the production of dry steam at all rates of combustion, the Yarrow large-tube and the later Babcock and Wilcox boilers have given the best results.

14. *Loss of Water.*—The loss of feed-water with each of the four types of boiler under consideration has been moderate throughout the committee's trials. In the runs to Gibraltar and back, carried out with the Medea and Medusa, the loss of water was small, being at the rate of 1.6 and 1.8 tons per 1000 horse power per day respectively. On the 140 hours' endurance trial of the Hermes the loss was 3.8 tons per 1000 horse power per day.

The loss of water may be expected to be greater in boilers fitted with many doors than in those fitted with but few, and to increase as the doors and joints become worn. In this respect the Yarrow boiler, having only three manhole doors, has an advantage.

15. *Examination and Cleaning of Interiors of Tubes.*—Of the boilers tried by the committee, the Yarrow boiler can be internally examined and cleaned in the shortest time and with the least amount of labor—to obtain access for such an examination and cleaning it is only necessary to remove three manhole doors. The Babcock and Wilcox type is less easily examined and cleaned—two small doors have to be removed for each tube, and these have to be rejointed after the examination and cleaning have been completed. In order to carry out a thorough examination of the tubes of the Dürr boiler it is necessary to remove a hand-hole door at the front of each tube, the diaphragm washer of the internal tube, the internal tube itself and the cap-nut at the back end of the generating tube; but in order to carry out a thorough cleaning, it is also necessary to remove the generator tubes from the boiler; after the cleaning is complete, these have to be replaced, and this is a long and tedious process. The work connected with the examination and cleaning of the tubes of Niclausse boilers is very similar to that necessary with the Dürr boiler. Further, the cap-nut at the back end of the Dürr boiler tube permits of each tube being readily emptied, while owing to the back end of the Niclausse boilers being inaccessible, some process is necessary to emppty the tubes when required, such as blowing the water out of the tube by a special pump and hose.

The necessity for being able to withdraw each of the tubes in a direct line with its axis renders the clear space required for the installation of Dürr and Niclausse boilers considerably more than would be required for boilers of other types. For warships, where the stoke-hold space is very

limited, this must necessarily cause considerable inconvenience in the arrangement of pipes and auxiliary machinery.

16. *External Cleaning of Tubes.*—In both the Medea and the Hermes it is possible to partially clean the tubes externally, when the fires are alight, by means of air lances.

The tubes in the Medea can be thoroughly cleaned externally when the fires are not alight, as they can be swept in three directions—viz., from the furnace, from the smoke-box and from the front of the boiler. The tubes of the Dürr and Niclausse boilers cannot be so thoroughly cleaned externally in place as those of the Medea, the number of rows being greater, and the overlapping of the baffles preventing portions of certain tubes being touched. In the Babcock and Wilcox boilers the tubes can be swept horizontally through side doors fitted to the casings; but as the boilers in the Hermes were originally fitted, the sweeping in a vertical direction was difficult. After the alterations of baffling, the sweeping vertically can be carried out, but this necessitates the removal of portions of the baffles. It is to be recognized that any system of baffling among the tubes, however it may improve the circulation of the gases, renders the cleaning of the tubes themselves more difficult.

17. *Bending of Tubes.*—After the Medusa had completed her preliminary runs, it was found that all the tubes of the bottom rows had curved upwards in the middle, the maximum bending being 1 1-16 inches, and these tubes were removed and straightened before starting on the committee's trials. These tubes had to be straightened again in August, 1903, and again at the conclusion of the committee's trials in February, 1904. When the committee visited H. M. S. Berwick in April, 1904, it was noticed that the tubes of the bottom rows of the boilers (Niclausse type) were bent upwards, and the members were informed that the maximum bending on March 22, 1904, was 5/8 inch. The ship was new in 1903, and only commissioned in December of that year. With the Niclausse, and also with the Dürr boiler, considerable bending of the tubes of the bottom rows must be expected; and it will be necessary to straighten these tubes when the amount of bending exceeds 3/4 inch. This will entail a considerable amount of extra works with these types of boiler, and they will be off service for corresponding periods. The upward bend of the generator tube is often greater than the space between the inner and outer tubes; and as the inner tube, which is only supported at the two ends, remains straight, it is liable to touch the outer tube at some point, thus impeding the circulation of water between them. To prevent this it may be necessary to support the inner tube at the middle of its length as well as at the back end, so that it must bend with the outer tube.

In the case of the Yarrow boilers of the Medea, the committee experimented in six of the boilers with the fire rows of tubes purposely bent, as described in the report on the trials of the Medea and Medusa, with the object of overcoming some slight leakages of tube ends, which showed themselves when working under forced draft. In two boilers the tubes of the fire-rows were left straight. Although these bent slightly in use, no trouble was experienced with them; and, during the later trials, these boilers proved to be as satisfactory, as regards freedom from leakage, as those in which the fire rows had been put in bent. The committee have suggested in their letter of December 21, 1903, concerning the Yarrow boilers proposed for H. M. S. Warrior, that the tubes of the fire rows should be bent 1 inch from the straight, and this recommendation they think should apply to future designs.

In the Babcock and Wilcox boilers of the Hermes, although some of the tubes of the bottom rows have bent, no leakage of tube ends has resulted, and it has not been necessary to remove any tubes for straightening or renewal.

18. *Corrosion of Tubes and Wear of Casings and Up-takes.*—In none of the four types of water-tube boiler which were recommended for trial by the committee has there been any considerable corrosive decay of tubes,

and the ordinary wear has been very slight. On the conclusion of the committee's trials the tubes of the boilers of the Medea and Hermes had not deteriorated to any appreciable extent. This applies also to the Medusa, except that the internal tubes have shown signs of roughening.

In the Medusa (Dürr boilers) there was some buckling of the side casings of the boilers, and some of the casing doors at the back of the boilers became warped and burnt.

No trouble was experienced in connection with the casings and up-takes of the Yarrow boilers of the Medea, and very little with those of the Babcock and Wilcox boilers of the Hermes. From the experience of the committee with the boilers of the steamship Martello, employed on the Atlantic trade for nearly four years, and also from their experience to date with the Hermes, it is considered that the durability of the casings and up-takes of Babcock and Wilcox boilers will prove to be satisfactory under the ordinary conditions of naval service.

In the Yarrow boiler, the temperature of the furnace gases is considerably reduced before they reach any part of the side casings; and, in consequence of this moderate temperature, the casing and up-takes of the Medea's boilers were uninjured on the conclusion of the committee's trials.

In this respect the Yarrow boiler is superior to the other types of water-tube boiler which have been tried by the committee.

19. *Liability to Damage from Being Forced.*—The makers of the Dürr boilers stated that not more than 35 lbs. of coal should be burnt per square foot of fire-grate per hour in the Medusa. The committee consider that this limitation of the quantity of coal to be burnt was prudent, as the overheating and bending of tubes in one of the boilers during the full power homeward run from Gibraltar were, in the opinion of the committee, due to the fact that the safe limit had been exceeded. It is also considered that the limitation of the amount of coal to be burnt per square foot of grate applies with even greater force to the Niclausse boiler, as the supply of water to the tubes is freer in the case of the Dürr boiler than in that of the Niclausse. As the result of their trials, the committee find that the Yarrow boiler can be severely forced without danger, and that the Babcock and Wilcox boiler can with safety be forced to the extent shown in the report.

20. *Skilled Firing Required.*—The satisfactory stoking of water-tube boilers requires a higher degree of skill than that of cylindrical boilers, and this is more necessary with the large grates of the Dürr, Niclauses and Babcock and Wilcox boilers than with the smaller grates and better shape of combustion chamber of the Yarrow. The stoking in the Medea, Medusa and Hermes was good throughout the trials, and towards the end was excellent. Under ordinary service conditions, such good firing can hardly be expected, at least until a vessel has been some time in commission. Good results can, however, be obtained with Yarrow boilers with engine-room complements new to the ship, as shown by the trials to Malta and back, which have been made by the Medea since the completion of the committee's trials with that vessel.

21. *Superheated Steam.*—The Dürr boiler was the only one tried by the committee which had any arrangements for superheating. It was fitted with complicated directing-plates in the steam-collector and with superheater tubes. The fittings in the steam-collector are undesirable, and they and the superheater tubes will probably require frequent renewal, while the amount of superheat obtained by their use was small, even when the temperature of the funnel gases was abnormally great. The results obtained were not sufficient to enable the committee to express any opinion as to the value of superheating as applied to naval boilers.

22. *Feeding of the Boilers.*—No trouble has been experienced with the feeding of any of the four types of boilers under consideration. In the Medea and Medusa the boilers were fitted with automatic feed regulators. It was found, however, that these were not sufficiently sensitive in opening

and closing (allowing a variation of level of about 6 inches in the gauge glass); the feed was, therefore, regulated throughout the trials by hand, no trouble being experienced in doing this. For a similar reason the feed was regulated by hand in the Hermes during the trials. In the Medea the feed-regulators were inside the steam-collectors, and interfered with the examination and cleaning of the middle rows of tubes. The committee considers that the balance of advantages rests with the omission of the automatic feed-regulators in boilers—such as the Yarrow large-tube and the Babcock and Wilcox—where there is a large reserve of water in the boiler.

23. *Salt Water.*—The report on the trials of the Medea and Medusa contains a description of experiments made on the Yarrow and Dürr boilers in regard to their behavior when working with brackish water. These experiments, so far as they went, indicated that neither type of boiler was likely to give trouble from this cause. In the case of the Yarrow boiler this result has been corroborated by the fact that on a recent voyage the Medea is reported to have had leaky condenser tubes, and a corresponding density in the boilers, without any bad effect.

24. *Relative Weights.*—In the case of the Hermes, the Medea and the Medusa, the new boilers were installed without any alterations being made in the stoke-hold floor spaces. A comparison of weight and maximum output of the boilers gave results tabulated on this page.

25. The committee are under great obligations to Mr. C. J. Wilson, F. C. S., who has, during the four years of their work, given his valuable personal attention to the analyses of funnel gases and of coal samples without any remuneration. They are also much indebted to Messrs. Thomas Wilson, Sons & Co., for permission to examine the boilers of the steamship Martello, and to Mr. W. S. Hide, the superintending engineer of that company, for affording the committee facilities for carrying out the inspections and giving information concerning the results obtained in the running of that vessel.

Weights and Maximum Output of Various Types of Boilers.

Type of Boiler.	Ship.	Weight of Boiler-Room Installation.	Maximum Output of Steam per Hour.	Output of Steam per Hour per Ton of Boiler-Room Weights.	——
		tons	lb.	lb.	
Cylindrical..	Saxonia	1000 (about)	132,600	132.6	
"	Minerva	567	167,100	295	With retarders.
"	"	558	156,200	280	As originally fitted.
Belleville ...	Hyacinth	454	178,700	394	
Yarrow.....	Medea	330	157,500	478	
Dürr.....	Medusa	314	158,000	503	
Babcock and Wilcox ...	Hermes	490	200,000	410	With vertical baffles and forced air supply above the fires.
Ditto.....	Ditto	481	182,300	380	As originally fitted.
Ditto.....	Sheldrake	125	43,840	351	
Ditto.....	Esplègle	95	24,780	261	
Niclausse ...	Seagull	135	48,450	359	
Ditto.....	Fantôme	76 5	22,750	297	

26. The committee desire, in conclusion, to place on record their appreciation of the assistance which they have received from their secretaries. Captain Browning, R. N., acted as joint secretary until his appointment to H. M. S. Ariadne, in 1902. Engineer-Lieutenant W. H. Wood, R. N., has continued to act as secretary throughout their whole work. The diligence and energy which the latter officer has shown in carrying out his work, his knowledge of the scientific, as well as of the practical, side of marine engineering, and his capacity for dealing both with the details and with general organization, have been invaluable to the committee throug-out, and esppecially in connection with the carrying out of their boiler trials at sea, a work of no little difficulty and complexity; and they desire to bring his services to the favorable notice of their Lordships.

(Signed) COMPTON DOMVILE,
(Admiral and Chairman).
JAS. BAIN.
JOHN INGLIS.
ALEX. B. W. KENNEDY.
JOHN LIST.
J. T. MILTON.
JOS. A. SMITH.

WM. H. WOOD, Secretary.

Obituary

Rear Admiral Henry C. Taylor, U. S. Navy, the President of the U. S. NAVAL INSTITUTE, died on July 26, 1904, and by his death the Naval Institute lost a friend and counsellor whose interest in its welfare never abated.

Rear Admiral Taylor not only from time to time wrote papers upon professional subjects for the INSTITUTE PROCEEDINGS,—even when overburdened with work as Chief of the Bureau of Navigation contributing to the pages of the Institute a valuable paper on "The Fleet,"—but, what was of still more importance, the Institute could always count upon his moral support and his influence to aid in advancing its prosperity and usefulness.

By his high character and his distinguished abilities, Rear Admiral Taylor greatly honored the position of President of the Naval Institute which his untimely death has made vacant, and the Naval Institute together with the Navy at large mourns his loss.

LIST OF PRIZE ESSAYS.

1879.

Naval Education. Prize Essay, 1879. By Lieut-Com. A. D. Brown, U.S.N.

NAVAL EDUCATION. First Honorable Mention. By Lieut.-Com. C. F. Goodrich, U.S.N.

NAVAL EDUCATION. Second Honorable Mention. By Commander A. T. Mahan, U.S.N.

1880.

"The Naval Policy of the United States." Prize Essay, 1880. By Lieutenant Charles Belknap. U.S.N.

1881.

The Type of (I) Armored Vessel, (II) Cruiser best suited to the Present Needs of the United States. Prize Essay, 1881. By Lieutenant E. W. Very, U.S.N.

SECOND PRIZE ESSAY, 1881. By Lieutenant Seaton Schroeder, U.S.N.

1882.

Our Merchant Marine: The Causes of its Decline and the Means to be taken for its Revival. "Nil clarius aquis." Prize Essay, 1882. By Lieutenant J. D. J. Kelley, U.S.N.

"MAIS IL FAUT CULTIVER NOTRE JARDIN." Honorable Mention. By Master C. G. Calkins, U.S.N.

"SPERO MELIORA." Honorable Mention. By Lieut.-Com. F. F. Chadwick, U.S.N.

"CAUSA LATET: VIS EST NOTISSIMA." Honorable Mention. By Lieutenant R. Wainwright, U.S.N.

1883.

How may the Sphere of Usefulness of Naval Officers be extended in Time of Peace with Advantage to the Country and the Naval Service? "Pour encourager les Autres." Prize Essay, 1883. By Lieutenant Carlos G. Calkins, U.S.N.

"SEMPER PARATUS." First Honorable Mention. By Commander N. H. Farquhar, U.S.N.

"CUILIBET IN ARTE SUA CREDENDUM EST." Second Honorable Mention. By Captain A. P. Cooke, U.S.N.

1884.

The Reconstruction and Increase of the Navy. Prize Essay, 1884. By Ensign W. I. Chambers, U.S.N.

1885.

Inducements for Retaining Trained Seamen in the Navy, and Best System of Rewards for Long and Faithful Service. Prize Essay, 1885. By Commander N. H. Farquhar, U.S.N.

1886.

What Changes in Organization and Drill are Necessary to Sail and Fight Effectively Our Warships of Latest Type? "Scire quod nescias." Prize Essay, 1886. By Lieutenant Carlos G. Calkins, U.S.N.

THE RESULT OF ALL NAVAL ADMINISTRATION AND EFFORT FINDS ITS EXPRESSION IN GOOD ORGANIZATION AND THOROUGH DRILL ON BOARD OF SUITABLE SHIPS. Honorable Mention. By Ensign W. L. Rodgers, U.S.N.

1887.

The Naval Brigade: its Organization, Equipment and Tactics. "In hoc signo vinces." Prize Essay, 1887 By Lieutenant C. T. Hutchins, U.S.N.

1888.

Torpedoes. Prize Essay, 1888. By Lieut.-Com. W. W. Reisinger, U.S.N.

1891.

The Enlistment, Training and Organization of Crews for our Ships of War. Prize Essay, 1891. By Ensign A. P. Niblack, U.S.N.

DISPOSITION AND EMPLOYMENT OF THE FLEET: SHIP AND SQUADRON DRILL. Honorable Mention, 1891. By Lieutenant R. C. Smith, U.S.N.

1892.

Torpedo-boats: their Organization and Conduct. Prize Essay, 1892. By Wm. Laird Clowes.

1894.

The U.S.S. Vesuvius, with Special Reference to her Pneumatic Battery. Prize Essay, 1894. By Lieut.-Com. Seaton Schroeder, U.S.N.

NAVAL REFORM. Honorable Mention, 1894. By Passed Assistant Engineer F. M. Bennett, U.S.N.

1895.

Tactical Problems in Naval Warfare. Prize Essay, 1895. By Lieut.-Com. Richard Wainwright, U.S.N.

A SUMMARY OF THE SITUATION AND OUTLOOK IN EUROPE. An Introduction to the Study of Coming War. Honorable Mention, 1895. By Richmond Pearson Hobson, Assistant Naval Constructor, U.S.N.

SUGGESTIONS FOR INCREASING THE EFFICIENCY OF OUR NEW SHIPS. Honorable Mention, 1895. By Naval Constructor Wm. J. Baxter, U.S.N.

THE BATTLE OF THE YALU. Honorable Mention, 1895. By Ensign Frank Marble, U.S.N.

1896.

The Tactics of Ships in the Line of Battle. Prize Essay, 1896. By Lieutenant A. P. Niblack, U.S.N.

THE ORGANIZATION, TRAINING AND DISCIPLINE OF THE NAVY PERSONNEL AS VIEWED FROM THE SHIP. Honorable Mention, 1896. By Lieutenant Wm. F. Fullam, U.S.N.

NAVAL APPRENTICES, INDUCEMENTS, ENLISTING AND TRAINING. The Seaman Branch of the Navy. Honorable Mention, 1896. By Ensign Ryland D. Tisdale, U.S.N.

THE COMPOSITION OF THE FLEET. Honorable Mention, 1896. By Lieutenant John M. Ellicott, U.S.N.

1897.

Torpedo-boat Policy. Prize Essay, 1897. By Lieutenant R. C. Smith, U.S.N.

A PROPOSED UNIFORM COURSE OF INSTRUCTION FOR THE NAVAL MILITIA. Honorable Mention, 1897. By H. G. Dohrman, Associate Member, U.S.N.I.

TORPEDOES IN EXERCISE AND BATTLE. Honorable Mention, 1897. By Lieutenant J. M. Ellicott, U.S.N.

1898.

Esprit de Corps: A Tract for the Times. Prize Essay, 1898. By Captain Caspar Frederick Goodrich, U.S.N.

OUR NAVAL POWER. Honorable Mention, 1898. By Lieut.-Com. Richard Wainwright, U.S.N.

TARGET PRACTICE AND THE TRAINING OF GUN CAPTAINS. Honorable Mention, 1898. By Ensign R. H. Jackson, U.S.N.

1900.

Torpedo Craft: Types and Employment. Prize Essay, 1900. By Lieutenant R. H. Jackson, U.S.N.

THE AUTOMOBILE TORPEDO AND ITS USES. Honorable Mention, 1900. By Lieutenant L. H. Chandler, U.S.N.

1901.

Naval Administration and Organization. Prize Essay, 1901. By Lieutenant John Hood, U.S.N.

1903.

Gunnery in Our Navy. The Causes of its Inferiority and Their Remedies. Prize Essay, 1903. By Professor Philip R. Alger, U.S.N.

A NAVAL TRAINING POLICY AND SYSTEM. Honorable Mention, 1903. By Lieutenant James H. Reid, U.S.N.

SYSTEMATIC TRAINING OF THE ENLISTED PERSONNEL OF THE NAVY. Honorable Mention, 1903. By Lieutenant C. L. Hussey, U.S.N.

OUR TORPEDO-BOAT FLOTILLA. The Training Needed to Insure its Efficiency. Honorable Mention, 1903. By Lieutenant E. L. Beach, U.S.N.

1904.

The Fleet and its Personnel. Prize Essay, 1904. By Lieutenant S. P. Fullinwider, U. S. N.

A PLEA FOR A HIGHER PHYSICAL, MORAL, AND INTELLECTUAL STANDARD OF THE PERSONNEL FOR THE NAVY. Honorable Mention, 1904. By Medical Inspector Howard E. Ames, U. S. N.

NOTICE.

The U. S. Naval Institute was established in 1873. having for its object the advancement of professional and scientific knowledge in the Navy. It now enters upon its twenty-eighth year of existence, trusting as heretofore for its support to the officers and friends of the Navy. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers and communications upon subjects of interest to the naval profession, as well as by personal support and influence.

On the subject of membership the Constitution reads as follows:

ARTICLE VII.

Sec. 1. The Institute shall consist of regular, life, honorary and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fee to the Secretary and Treasurer, or to the Corresponding Secretary of a Branch. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

Sec. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control, and a vote equal to one-half the number of regular and life members, given by proxy or presence, shall be cast, a majority electing.

Sec. 5. Associate members shall be elected from officers of the Army Revenue Marine, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: "Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control, and, if their report be favorable, the Secretary and Treasurer shall make known the result at the next meeting of the Institute, and a vote shall then be taken, a majority of votes cast by members present electing.

The Proceedings are published quarterly, and may be obtained by non-members upon application to the Secretary and Treasurer at Annapolis, Md. Inventors of articles connected with the naval profession will be afforded an opportunity of exhibiting and explaining their inventions. A description of such inventions as may be deemed by the Board of Control of use to the service will be published in the Proceedings.

Single copies of the Proceedings, $1.00. Back numbers and complete sets can be obtained by applying to the Secretary and Treasurer, Annapolis, Md.

Annual subscriptions for non-members, $3.50. Annual dues for members and associate members, $3.00. Life members fee, $30.00.

All letters should be addressed to Secretary and Treasurer, U. S. Naval Institute, Annapolis, Md., and all checks, drafts and money orders should be made payable to his order, without using the name of that officer.

OFFICERS OF THE INSTITUTE.

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CAPTAIN W. H. BROWNSON, U. S. NAVY.

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Lieutenant J. M. POYER, U. S. Navy.
Lieutenant W. H. G. BULLARD, U. S. Navy.
Lieutenant R. H. JACKSON, U. S. Navy.
Professor N. M. TERRY, A. M., Ph. D.
Professor PHILIP R. ALGER, U. S. Navy. (ex-officio.)

SPECIAL NOTICE.

NAVAL INSTITUTE PRIZE ESSAY, 1904.

A prize of two hundred dollars, with a gold medal, and a life-membership in the Institute, is offered by the Naval Institute for the best essay presented on any subject pertaining to the naval profession, subject to the following rules:

1. The award for the prize shall be made by the Board of Control, voting by ballot and without knowledge of the names of the competitors.

2. Each competitor to send his essay in a sealed envelope to the Secretary and Treasurer on or before January 1, 1904. The name of the writer shall not be given in this envelope, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary and Treasurer, with the motto on the outside and writer's name and motto inside. This envelope is not to be opened until after the decision of the Board.

3. The successful essay to be published in the Proceedings of the Institute; and the essays of other competitors, receiving honorable mention, to be published also, at the discretion of the Board of Control; and no change shall be made in the text of any competitive essay, published in the Proceedings of the Institute, after it leaves the hands of the Board.

4. If, in the opinion of the Board of Control, the best essay presented is not of sufficient merit to be awarded the prize, it may receive "Honorable Mention" or such other distinction as the Board may decide.

5. In case one or more essays receive "Honorable Mention," the writer of the first of them in order of merit will receive seventy-five dollars and a life-membership in the Institute.

6. Any essay not having received honorable mention, may be published also, at the discretion of the Board of Control, but only with the consent of the author.

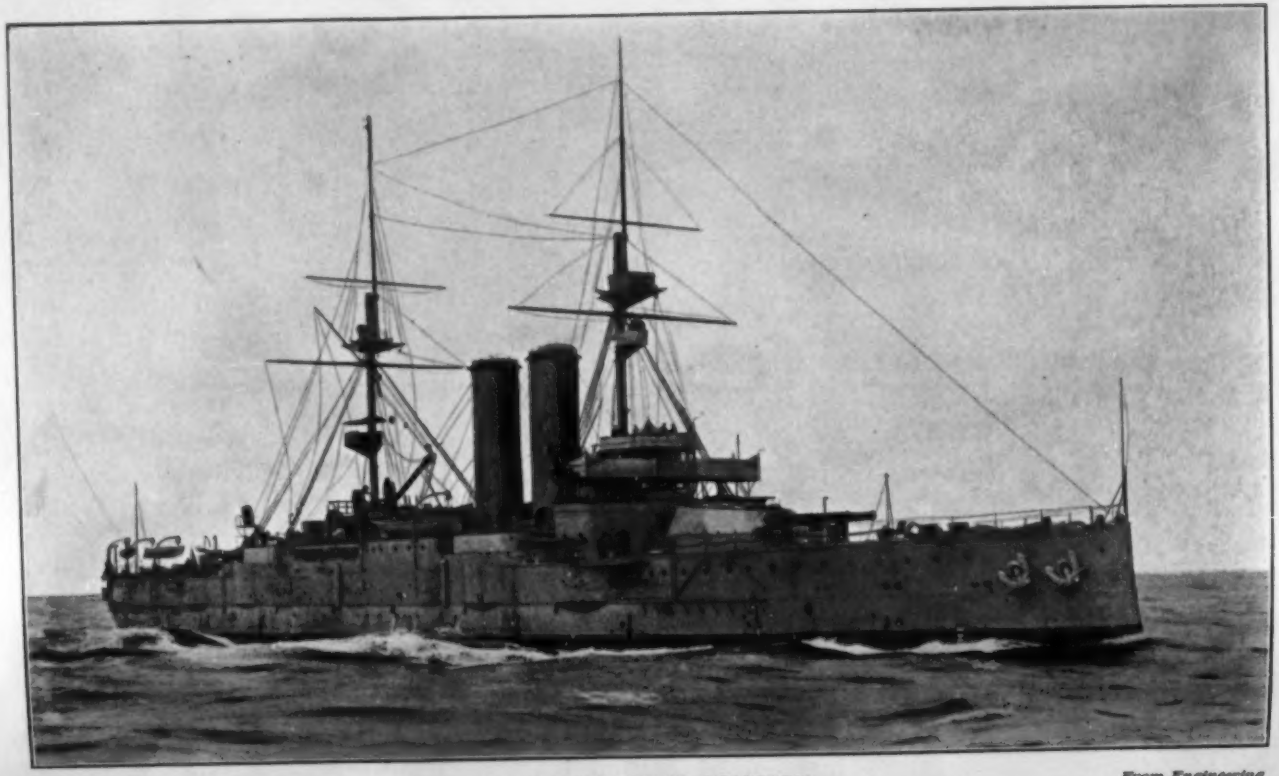
7. The essay is limited to fifty (50) printed pages of the Proceedings of the Institute.

8. All essays submitted must be either typewritten or copied in a clear and legible hand.

9. In the event of the Prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of the gold medal.

By direction of the Board of Control.

PHILIP R. ALGER,
Professor, U. S. N., Secretary and Treasurer.



H. M. BATTLESHIP DOMINION

From Engineering